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The Past Month.

The month of December did not bring the complete revival in business predicted in some quarters nor the general slump expected in others. That there has been a distinct gain can scarcely be denied. The chief obstacle to the revival of business in general and mining in particular, the lack of transportation, has not been entirely removed. The great cyanide camps are still awaiting shipments of cyanide and dynamite, and the smelters of the A. S. & R. Co. are all ready to do business, the extent of their operations being limited at each plant by the ability of the railroads to bring in the ore and especially the fuel. With the restoration of traffic now promised should come as great a revival in mining as it is reasonable to expect in view of the abnormal state of the world's metal market.

The danger of a cyanide famine seems to have passed. Several mills have during the month run short of supplies, but in nearly every case this was due to transportation difficulties and not to failure of the manufacturers to produce a sufficient supply. Even though supplies from Germany should be cut off for months to come it is said the factories in England, the United States and Canada will have sufficient capacity to keep the mills running. Some orders from important consumers in Mexico were placed directly with the English makers during the month.

The shortage of dynamite has not as yet been relieved. Several important mines have been forced to curtail operations for lack of sufficient explosive. Interrupted traffic was in some cases the cause of failure to deliver dynamite in sufficient quantities, but much difficulty has also been caused by uncertainty as were, when and of whom purchases would be permitted. A few of the more important interests have taken the bull by the horns and have placed independent orders outside Mexico, and are prepared to take their chances in the matter of extraordinary taxes, etc.

The ability of the railroads to handle the business offered will determine whether the revival will be rapid or the reverse. A marked improvement is already noted, and more is prophesied for the near future.

New Decrees Affecting the Mining Industry

Two decrees published during the past month by the Provisional Government seem to be intended to simplify the relations between the Administration and the mining interests.

On Dec. 20 appeared a decree extending "the time allowed for the revalidation of titles of mining property to Mar. 15, 1915." The purpose of this regulation is obvious. The extension of time is for the convenience of holders of titles who may find in difficult to secure a revision of their papers in the short time allowed in the original decree.

The decree reforming the taxation of gold and silver,

published on Dec. 24, appears in full on another page of the present issue. It appears from the text that the special war tax imposed last spring is removed. The net change as compared with the tax in force during the last few months will, it is expected, be small, the charges on gold being somewhat higner. As compared with the tax collected in pre-revolutionary days, the present tax is a fixed per kilo charge, payable in currency not subject to fluctuations of local exchange, while the old rates were percentage rates calculated on the market value of the metals in terms of the legal tender of the country.

New Tax on Gold and Silver.

On Dec 24, a new decree taxing silver in bars or alloy $1.80 per kilo, and in any other form $2.20 per kilo, and gold in bars or alloy $64 the kilo and $80 the kilo in any other form was published by President Gutierrez through the finance department. The tax covers silver or gold produced in this country or imported from without, and is payable in Mexican gold. All other taxes on produced or imported silver or gold are cancelled.

The decree is as follows:

"Eulalio Gutierrez, provisional President of the Mexican United States, to the inhabitants thereof, know ye:

"That in excercise of the extraordinary faculties wherewith I am invested, I have seen fit to decree the following:

"Article 1.—The tax on gold and silver produced in the republic or which are brought from foreign countries shall be levied in the future as follows:

"A.—If the silver is pure or alloyed in the form of bars, it will be taxed at the rate of $1.80 Mexican gold the kilo, and if in any other form $2.20 Mexican gold the kilo will be charged.

"B.—$64 Mexican gold the kilo will be charged on gold pure or alloyed in the form of bars, and $80 the kilo if in any other form.

"Article 2.—The payment of the tax referred to in the foregoing article must be made in the form of stamps of the government which will be worth $500, $100, $50, $20, $10, $5, $1, $0.50, $0.20, $0.10 $0.02, $0.01 respectively, and will be sold at their par value precisely for gold coin according to the conditions fixed in the law of March 25, 1905, or for dollars at the rate of one dollar for every two pesos. Said stamps will have an overstamp with the words "Oro Mexicano."

"Article 3.—There will be no tax on gold, silver and samples of ore under the conditions set forth in article 5 of the law of March 25, 1905.

"Article 4.—Only with the approval of the ministry of finance, and in each case, with previous bonding, may payment of the tax be admitted in the form of drafts or checks on foreign countries, but the office which collects the tax may affix immediately on the document which it issues the corresponding stamps, making a note to the effect that their amount was covered with a draft or check, as the case may be.

"Article 5.—The tax which must be collected will be paid in the mint and federal assay offices, and, exceptionally, in the frontier and marine custom houses. The metallurgical companies may, through a special concession of the ministry of finance, present in their own establishments the products destined for exportation, to the end that the personnel of the respective federal office make the assay and collect the taxes which are due. The salary of said personnel and the cost of the trip and any other expenses which may arise will be paid by the interested parties.

"Transitory Articles."

"First.—This decree will go into force on the date of its publication.

"Second.—Beginning with the same date the decree of April 24 of the present year is derogated as well as the provisions of the law of March 25, 1905 and its amendment of the 30th of the same month and year which are opposed to the precepts of this decree.

"Therefore I order that this be printed, published, circulated and given due fulfilment.

"Constitution and Reform. Given in the National Palace of Mexico, December 24, 1914.

(Signed) "E. GUTIERREZ."

What Metallurgy Owes to the Technical Men.

A reader inquires in a manner which seems to show that he thinks no answer possible: "What have the technical fellows done for metallurgy during recent years?"

By technical fellows, he probably means the men who have made a scientific study of the subject, and since metallurgy is a branch of chemistry, more especially those who try to understand the chemical facts which are the foundation of every process for the separation of metals from their ores. Perhaps the development of smelting and the introduction of cyaniding are events too ancient to merit his consideration. Certainly it would be difficult to find any improvement introduced by the purely "practical man" to equal in importance the introduction of slags the fusibility and composition of which can be predicted without fail or the application of a solvent which has increased the production of both gold and silver from low grade ores to such an extent that many claim that even gold is now too cheap for convenience.

Passing the invention of the pulp thickener, continuous counter-current decantation, which employ principles perhaps too simple to be called technical without exciting protest, we may call attention to the application of reduction or wet desulphurization in cyaniding, which promises to be revolutionary enough to convince the most skeptical. Besides, who but the "technical fellows" have gradually reduced the cost of cyaniding by reducing strengths of solutions and introducing economies everywhere?

However, cyaniding is as yet so little developed and so imperfectly understood that it will be perhaps more fair to look for examples in another direction. Take the work done by a few specialists in the copper camp of Anaconda, in Montana, during the past few years. In slime concentration they introduced the twenty-deck round table and the ingenious use of Dorr thickeners to handle per twenty-four hours 2,500 tons

of extremely fine slime. contained in 26,000,000 gallons of pulp. Upon this followed the introduction of a leaching process for sand tailings theretofore considered of too low grade for any hope of funther extraction. A 2,500-ton plant is now in successful operation. Leaching required cheap sulphuric acid and the production of that on a large scale followed as a natural consequence. Since more sulphuric acid can be conveniently produced than is required in leaching, the excess will, according to a recent report, be used to produce phosphate fertilizer. Flotation is now under investigation and also the smelter fume question. It now seems that the immense flue system for the collection of dust may be abandoned entirely.

That is the record for Anaconda alone during a very brief period. Surely our inquiring friend could easily find other excuses for the technical man if he would but try. How about pyritic smelting and bessemerizing matte, or if these are too far past, how would sintering roasting suit his purpose?

Work of the Tube Mill

Upon another page of the present issue we print an article on tube milling that should set many of the mill operators in the country to thinking. From the results presented it appears that the tube mill is not by any means the simple grinder that its usual treatment would lead one to think. Evidently there are a large number of conditions that influence the work done, and to ignore any of these conditions is not wise if not altogether fatal.

When the tube mill was first introduced in cyanide mills it was supposed to be the simplest of grinding apparatus, merely a revolving cylinder in which ore was introduced at one end, ground by the impact and attrition of rounded pebbles and the ground material withdrawn from the other end. It was assumed that the amount of grinding depended upon the amount of power applied, and the finer the ore introduced as feed the finer the resulting pulp. The function of the water or the solution in the feed was merely to carry the ore particles through, and incidentally to prevent dusting. With 50 per cent moisture in the pulp the launders, the mill and the cone thickeners gave little or no trouble, and that proportion was widely adopted and is in fact still in almost general use. There was no particular reason for the adoption of 50-per cent moisture except that of its convenience.

The results of the work done by Caldecott and his associates in South Africa a few years ago were rather startling to mill operators who wished to do things as they should be done. The reduction of the moisture in the tube mill feed was shown to increase the grinding capacity under certain conditions by as much as 40 per cent. But in most mills the handling of pulp so thick as that prescribed was inconvenient and troublesome. It caused clogging of the cones, choking of launders and constipation of the mill. So the 38 per cent moisture doctrine was accepted as a sort of human ideal toward which one should strive as a desirable end rather difficult of attaiment. Tube mill practice is still governed by reasons of convenience and not by tonnage and screen test.

Now it appears that the 38 per cent doctrine is true only with a certain set of conditions, that to adhere to is in some cases means the waste of a large proportion of tube mill space and of power. It appears that under certain conditions a mill working on 50-per cent pulp may do scarcely any work at all. The author shows that even 25 per cent moisture may sometimes be too large a proportion, and that the size of material fed, difference in level of feed and discharge and other conditions should govern the percentage of moisture employed. The proper test of the work of the mill is said to be the rise of temperature of the shell, the heating of the mill still so much feared by shift-bosses.

The opinion expressed elsewhere in this issue is that the tube mill feed should be just thick enough to cause adhesion of the ore particles to the surface of the pebbles, insuring a coating and a maximum grinding effect in whatever direction the pebble may fall strike or slide. The proportion of moisture required to give this effect would depend upon the shape of the particles as well as upon their size and whether composed of clean quartz or clayey compounds.

Since the tube mill has become the chief dependence for grinding in our mills, stamps, rolls, etc. coming to rank more and more as mere accessories, it will pay millmen to study carefully the conditnons under which their mills operate, for it appears that in tube milling also every case is a distinct problem.

The Metal Markets

The abnormal condition of the metal markets promises to do as much as local disturbances to delay the return of the revival in mining in Mexico. Of course this condition is as abnormal as the European war, which seems to be the chief cause of the low prices, and it will as surely end. In the meantime 50 cents per ounce of silver and 13 cents per pound of copper, the prices quoted about the middle of last month, offered little inducement for expansion and still less for the launching of new mining enterprises.

About the causes that have brought about and maintained these low prices there is still a great difference of opinion. That the war, by interfering with the free movement of cargoes, cut off a considerable part of the market is undoubtedly true, but the forcible withholding of shipments to countries at war does not alone account for the almost total lack of demand and the extremely low prices. The price of copper has recovered somewhat since the beginning of November, but optimism would be premature if based upon this only. It must be remembered that when the trouble began production in the United States was reduced by one half, and the recovery of a cent of two on one half the normal supply is still far from reassuring. As buyers Germany and Austria are completely removed from the market, but those countries, even in most active times, never took one half the world's output. Besides, Germany has had a considerable tonnage from its own mines, and much of the copper imported found its way into the export column in the form of various manufactured products, especially wire.

The chief cause for the lack of movement in metals must be sought elsewere, probably in the general

anxiety as to the future and in the business depression which is one of the indirect results of the European upheaval. It is the general opinion that business will come back with a bound as soon as the end of hostilities appears in sight, and also that the improvement will continue gradually even if the war endures many months longer. In the meantime the sooner the warring nations in Europe compose their differences the better it will be for the mining industry in Mexico.

Colonel Tepetate.

"I am working with an expert on a new system of accounting for my outfit," remarked the Pessimist as nearly an optimist for the moment as it is possible for him to be.

"While you're about it," remarked the Colonel, "you'd better make sure that you get the system and that the system doesn't get you. When it gets so complicated that it ties you hand and foot, a system isn't much of an investment. It makes a good peon but I feel sorry for you if it should begin to boss you around."

"Can't have too much system in any business," snapped the Pessimist nettled. "Look at the U. S. postoffice department. System to the last bit of string and the most efficient thing on earth. There are checks and counter-checks and rules so that a person simply can't go wrong. Responsibility is almost eliminated, and if anybody makes a mistake it is found out right away."

"Yes, and all the jefes are so many clerks, all have to put down the figures on a certain line and all 'sigh here, please.' With a huge affair like that it must be done in that way, I suppose, and it works well. Yet, when the mails quit coming through Laredo the other day, it took that beautiful system about ten days to switch it over to El Paso. As I size it up system means red tape, and red tape is a brake on your movements always. Perhaps it is good for us—sometimes, not always."

"Nothing can be worse than business without system."

"Except system without business. I once knew a young fellow who had a wonderful system for keeping his personal accounts. He made ten dollars a week and his expenses amounted to ten dollars because they couldn't be any more. After a couple hours' figuring Saturday nights, he could generally make things balance within a cent or two. I drew down twelve dollars in the same store and that lasted me until along about Wednesday. I never figured up, but my balance was always right to a cent. Under the circumstances I still think my system was the best. A system has got to fit the case or the red tape is pure loss. I have seen many a good man tied up and thrown by red tape, and I have seen it fool more than one of the gentlemen in white vests who boss things from the main office some thousands of miles away."

"Pooh! That's exactly what a system is for—to prevent the managers from fooling the man who sits in the middle of it."

"Yes, that's the intention," returned the old man. "But it doesn't always work out that way. You see, a system is never quite complete. It is supposed to cover everything, but it never does. The heads of departments are supposed merely to fill in little squares in report blanks, and to save their heads for holding up their sombreros. It is a pity but it's true that the manager comes across something several times a day that won't fit in any of the little squares. To be sure, there is a little space for remarks about one inch long at the right of the sheet. But you can't swear and ease your mind on a report blank, nohow. Now, I hold that every mine manager has got to swear once in so often, and if the first chief head boss never hears his managers swear he doesn't know what is going on."

The pesimist looked unconvinced.

"There may be a little square for putting down the time lost when a gasket blew out of the air main." went on the Colonel in explanation. "But when it comes to a tube-mill feed-pipe choked up with track spikes, a manager would need at least ten sheets to explain what those spikes were doing there, at least if he cared to keep out of trouble, and most managers do. So he smooths that over. Don't ask me how. Since mining camps partake of their full share of the natural cussedness of things, that sort of thing happens pretty regularly. In the meantime the chief boss can tell from the reports exactly where each loose bolt went to. As a matter of fact, he hasn't the slightest idea of what's going on."

"And then?"

"The manager can't hire or fire much of anybody without consulting the chief, and everybody lies awake nights trying to make that system save his own hide. The slick boys, whose conscience never hurts them, are the ones who succeed. Once in too seldom the big noise in the main office takes a fall to things and proceeds to fire a bunch by mail, with a curious fatality always landing on the wrong man. So it goes until everybody who can't make that system fit any known crime is weeded out. Then everything goes along as smooth as pie, but if the chief boss could only see things as you and I have seen them-Wow!"

"That head boss of yours is qualified fool."

"That is what everybody around the works thinks, especially those with a pull. But you're all wrong. If he were a fool he wouldn't be where he is. No, he is merely carrying a good thing too far."

"You've got to let the manager use a little sense."

"That's precisely what these hairdrawn system won't do. There are no blanks for common sense. The best of them, or rather the worst of them, has no use for heads, only doorknobs. The system is supposed to supply all the sense, common or otherwise."

"Yet without system what can you do?"

"Nothing! You've got to have some system, but it isn't wise to let it tie everybody up with plowsteel rope. Every organization needs a few heads that will work without waiting for juice from headquarters; the rest may be doorknobs. But you can't run a mine with doorknobs only. As soon as a system tries to transfer all discretion, all sense and all brains to the main office, that system becomes too perfect for human use. A man is not a stamp battery. A little responsibility, a little authority, a little discretion does him good."

Pumps for the Mine and Mill.

Written for the Mexican Mining Journal
By T. E.Pratt *

The object of this little article is not to present new and startling facts for the experts who make a business of pumps. Its object is rather to recall certain things that are apt to be forgotten and which everybody about a mine and mill ought to know.

Pumps are devices for elevating liquids from a lower to a higher level. As such they are the most efficient and economical means for the purpose known. The design of a pump is to handle pure liquids only. Its valves and passages are arranged on the presumption that the material passing through them will flow freely in all directions, will not deposit solids and will remain uniform. It is, therefor, not fair to require a pump to handle material that is only partially liquid or contains grit or solids in suspension.

Courtesy Mexico View Co.

Cía. Santa Gertrudis, Pachuca, Hgo.

With certain modifications liquids carrying certain solids in solution or suspension may be handled, but to assume that any pump may be installed for raising pulp because some other pump does this work successfully must lead to disappointment.

Pumps should be designed and fitted for the work they are expected to do. For handling corrosive liquids special linings are employed according to conditions, linings of wood, cement, special bronzes or porcelain being used. Pumps for lifting acids are in some cases fitted with stoneware cylinders and plungers. Plunger pumps for work on slime should have no large horizontal passages or chambers in which the coarser portions of the pulp might settle out. Special valves are sometimes provided for slime pumps, depending upon the nature of the material handled. It is almost impossible to handle some pulps in pumps of the plunger type, especially if the pressure is considerable. Sharp quartz slime, even when very finely ground, has been known to cut out valves in a few hours in spite of every ingenuity of design and care in the selection of material. Centrifugal pumps used for slime are commonly fitted with removable steel liners which may be renewed when worn.

Pumps are built to run at a certain speed which for the size and make is the most economical. Attempts are occasionally made, and not necessarily in the distant wilds either, to increase the capacity of a pump by merely speeding it up, with subsequent wonder why the apparently indestructible standby should immediately proceed to shake itself to pieces. The reason lies in the inertia which is a property of all matter. The water in certain parts of the pump changes its direction of flow with each stroke of the plunger or piston, and to change the direction of motion of any mass requires a force which increases rapidly with the speed of change. In the same way valves must have time to seat properly, for pump valves are of considerable weight and are actuated by

* Engineer with Victor M. Braschi Machinery Co. Inc.

the push of the water itself and by gravity and springs.

In the case of centrifugal pumps the same law of inertia also forbids variation in speed. Although in this case there are no valves, the action of the pump depends upon changes of direction of motion, and the runners, or impellers, which give the impulse of lift are designed to give a maximum effect at a certain speed, and any variation affects the result.

Of the familiar types of pumps in use are the piston pump, usually steam-driven; plunger pumps, similar to piston pumps but having single-acting cylinders; centrifugal, usually driven directly by an electric motor; the spiral pump, familiar as the Frenier; and various devices depending upon the action of air pressure, in which class are the air-lift and the montejus useful in elevating acids.

Steam Pumps

The steam pump is the old familiar pump which has in the course of time been so improved and standardized that further improvements seem impossible. Since the adoption of electric power for general use, steam pumps are used only where electric power is not available, or so near to the boiler that the loss by condensation is small. For boiler feed the steam pump will probably always find a place. The steam pump is the simplest and most efficient of pumps, its only disadvantage being that if installed at a distance from the boiler the condensation in the steam pipe becomes too great for economy. Still, for certain purposes it has no rival. One of the most successful sinking pumps is a vertical plunger steam pump which may also be driven by compressed air. When the distance from the boiler becomes too great it can be connected with the air main. For underground use where air pressure is available and electric current is not, this type is very useful. The exhaust air after having driven the plunger aids in the ventilation of the mine.

It has been claimed that duplex pumps of this type, with two cylinders side by side, the piston rod of each actuating the valves of the other, have twice the capacity of a one-cylinder pump of the same dimensions. This is denied by rival manufactures, and apparently with good reason. It is impossible to pack the glands and pistons so accurately that the friction will be the same in the two moving systems. For this reason one piston is certain to lag behind the other and interfere with its action.

Power Pumps

The earlier types of power-driven pumps were merely the piston or plunger of the steam pump driven by a rod and crank, but the more extended use has developed machines which are distinct in every way. The introduction of electric drive has especially led to many modifications in the interest of space occupied, stability and convenience in making repairs. At the present stage of development it is unnecesary for anyone to buy a pump for any purpose, not entirely self-contained and all valves and essential parts readily accessible. Among the more recent improvements are a single base-plate which supports both a motor and its direct-driven pump so that the alignment remains unimpaired even if the foundation should give way, and separate pots to serve as cylinders for the plungers. In the older types of multiple-plunger pumps the cylinders were cast in one piece or in few pieces, so that if one gave way all had to be renewed. With separately cast pots, one may be replaced without disturbing the others.

A striking change in recent years has been the multiplication of plungers. In the old days one cylinder, or at most two, was considered enough, the air-chamber, being considered sufficient to eliminate the pulsations in the flow. Now one sees almost as many plungers as there are cylinders in the latest automobile; and the multiplication of cylinders has been with the same object in view—equalizing the effort and the result—The jerk of the belt at each revolution of a one-cylinder pump and the sudden spurt from the discharge pipe do not tend toward economy either in repairs or power. By driving general plungers from one shaft this unevenness may be removed as far as is desirable. The stream from the discharge of a triplex pump should show a variation of not more than 13 per cent, while with a quintuplex the fluctuation may be reduced to only 5 per cent. By increasing the number of plungers still further the variation is eliminated correspondingly. Considerations of first cost and economy must finally limit the number of plungers employed, and the popularity of the triplex type in the mills of Mexico seems to indicate that for the purposes there served three plungers fullfils most of the conditions desired. For high pressures, however, it is quite possible that ecconomy may require five or even more plungers.

Centrifugal Pumps.

Centrifugal pumps are not so efficient as plunger or piston pumps, but their low cost and great convenience have led to their very extensive use. The low efficiency of the centrifugal pump is due to the principle employed in its design. The stroke of a plunger in a reciprocal pump in good working order displaces a certain volume. If there are no leaks a stroke of the plunger will displace that volume of water whether the speed be great or small. In the case of a centrifugal pump the lifting impulse depends upon the centrifugal force with which the water is thrown out from the runner. There are no valves and the channels for the passage of water are open. When the speed is sufficiently low the water will flow back as fast as the runner or impeller forces it upward. In other words, the piston or plunger pump should have no slip, while the centrifugal pump, no matter how carefully built, must have a considerable slip and that operates against efficiency even at the most economical speed of the runner.

Since centrifugal pumps operate at high speeds they are usually driven directly by a motor mounted on the same shaft or by belt. With this type a constant speed is even more important than with the reciprocal types. The lines of the runner and the casing are designed for a certain speed, and any variation from this chosen velocity of rotation will affect the result. In a general way it may be said that head and speed vary together. When the speed is changed the capacity is changed in direct proportion to the speed. The head changes as the square of the speed, and the power proportional to the cube of the speed.

Among the most notable improvements in centrifugal pumps is that of balancing the pressure upon the runner, either by double suction, admitting water equally to both sides, or by arranging the suction on opposite sides of two runners mounted on the same shaft. When the water is admitted to only one side of a rapidly revolving runner an enormous pressure develops on one side which is supported by a thrúst bearing on one end of the shaft. To overcome the disadvantages of these thrúst bearings the tanner is so designed that the pressure will fall equally on both sides. For the same purpose multiple-stage centrifugals, those having a number of runners mounted upon the same shaft, can be arranged into two units driven by a single motor In this case the electric motor is placed between the two pump units, the motor shaft being extended on both sides to connect by flexible couplings to the

pump shafts. The discharge of the first unit is connected to the suction of the second, the arrangement being such that the load on the motor is balanced as well as the pressure on the impellers.

A centrifugal pump with a single runner can not be made to lift to an indefinite height as is the case with a plunger pump in which the lift is limited only by the force applied to the plunger and the strength of the materials of construction. The lift of a single runner centrifugal pump, called for convenience a single-stage pump, is about 168 feet, although in practice it is customary to figure on much less. To secure greater lift in a single unit two or more runners, each with its proper casing, are mounted on the same shaft, the channels being so arranged that the water enters each in succession receiving from each its proportionate amount of lifting impulse.

The centrifugal pump has undergone many modifications to fit it for special conditions. Sinking pumps of this type are usually mounted upon a vertical shaft, the incased motor and the pump proper making a compact unit. For low lifts, as in the case of shallow wells it is often convenient to have the motor at the surface for easier inspection and care. In this case a frame carrying a shaft approximately the depth of the well or sump is employed, Another arrangement for lifting from a sump of small dimensions has a number of turbine runners mounted in a tubular casing which can be put down into the narrow sump.

Valves

Other things being equal it may be said that the efficiency of a piston or plunger pump depends upon the condition of its valves. The one care of the experienced pump man is his valves, and with long experience one becomes extremely expert in judging the condition of a valve by sound. A story is told of an old pump man who had for years been in charge of a praticularly cantankerous pump. The old man fell sick and the pump immediately began to "act up." The new man, the mechanics and all the superintendents and managers could do nothing with it. As a last resort they rigged up a telephone leading from the pump to the old man's bedside when his practiced ear promptly located the trouble.

It is largely due to difficulties with valves that plunger pumps are rejected for work on slimes in favor of centrifugal or spiral pumps. The nature of the slime handled determines the life of a valve or whether the pulp can be handled at all. High lifts and sharp quartz in the slime make the wear on valves prohibitive. A mill in Mexico some years ago installed a triplex plunger pump of the best type for elevating its slimes. The pump was specially constructed and had for valves cast iron balls. A reasonable efficiency could be maintained for only a few hours, and it was found that the balls which were expected to wear equally so as to preserve a sperical form soon assumed an egg shape with channels which were quickly eroded by the sharp quartz particles. Flat valves of the usual form were afterward tried with facings of rubber, fibre, canvas, etc., but it was found necessary to abandon entirely this means of elevating pulp. It was found that a mere scratch on the valve seat was sufficient to cause the particles of pulp to cut a channel of their own

Pump valves being actuated by the water pumps and by gravity and springs work best when seated on horizontal seat. This insures the simplest mechanism for opening and closing uniformly. For this reason pumps can not be "up-ended" or mounted anyhow like an electric motor. A horizontal steam pump can not be easily changed into a vertical sinker, which several practical men have found out at their own expense.

Air Lifts

The subject of air lifts is large enough for a separate article. It may, however, be said here briefly that as compared with that of pumps the efficiency is very low. Still economy does not altogether depend upon the efficiency of any particular machine. For elevating pulp the air lift has been found more economical than pumps, for the reason that slime pumps of the ordinary types demand a never ceasing supply of repairs and extra parts due to the scouring action of the sharp particles. Air lifts, on the other and, are free from all complications of valves, packing and liners and do their work with a minimum of attention and repairs.

San Rafael Mining Co., Pachuca, Hgo.

Assay of Tin Ores and Concentrates.

A series of tests which various minerals were added to tin ores and concentrates of known tin content, and the mixture then assayed for tin by the Pearce-Low method proved that the method is very accurate except when compounds of titanium, tugsten, or bismuth are present. The modification proposed when titanium is present, is to fuse the ore with potassium bisulphate, and treat the melt with dilute sulphuric acid. when all the titanium goes into solution and the residue, containing all the tin, is fused with sodium peroxide in the usual way. Tungsten, if present with titanium can be completely removed by treating the residue from the titanium solution with ammonium carbonate. Ores containing tungsten may also be digested, after finely powdering, with sodium hydroxide solution, when all the tungsten goes into solution. When tin ores contain bismuth, the bismuth is precipitated by the nickel. As the precipitate consums iodine, it must be removed by filtration, and the solution again reduced before titration. In general, in carrying out the Pearce-Low assay, the authors recommend grinding the sample to 100 mesh at least; fusion in nickel crucibles, and reduction with nickel; the temperature of the solution at titration to be below 70_0 F. (21° C.); avoidance of large amounts of cuprous chloride and ferrous chloride; the bulk of the solution before reduction to be 400 c.c., containing 125 c.c. of hydrochloric acid.—E. A. Wraight and P. L. Teed, Inst. Mining and Met.

Tube-Milling in All Slime Cyanide Practice.

There has been no lack of papers describing milling plants and the number of tube-mills installed, their sizes and arrangements. The principles underlying the operation of tube-mills have, however, with a very few exceptions been left to the individual operator. Opinions as to the action within the revolving drum, and the conditions which give the best results, are vague and vary greatly. Much of the more intelligent tube-mill practice of the past few years has been based upon the work of a scientific commision which investigated conditions of milling in South Africa. Conditions, however vary greatly, and much work remains to be done before tibe-milling can be said to be on a rational basis. The following article by one interested in getting the most possible out of his mills, which appeared in Chemical & Metallurgical Engineering, is, therefor, particularly welcome. The author, W. J. Pentland, says:

There seems to have been a general agreement among writers on the subjet of tube-milling for cyanidation that the most desirable moisture content of the pulp is 38 (and sixteen decimals) per cent. It is true that many accounts have been published that seem to demonstrate this figure the ideal one. It is true also, we believe, that almost all of the tube-mills used in the experiments on correct moisture content were of the trunnion, small-discharge-opening type. Many of the early ideas on tube-milling no longer hold good. For example, it used to be said that "the finer the feed going to the tube-mill, the greater amount of net fine grinding done," and "the longer the pulp can be kept in the mill, the finer it will be ground." Many such comments were considered sound once, but are no longer heard. We believe it not improbable, therefore, that the old standard of 38 (and so many decimals) per cent moisture may go the way of some other assumptions. We now find many operators specifying 35 per cent moisture as preferable; to-morrow they will be saying 33 per cent, and may some time hold to 30 per cent.

Individual experiments are helpful, but they are not conclusive. Experimental conditions are rarely realized in practice. We endeavor to have practical conditions in our experiments, but rarely get them. Then we are apt to persuade ourselves that in subsequent practice we have the conditions of the experiments. Further, design of machinery and methods of operation change from time to time, and the standards of one period become untenable as practice as an art progresses. Thus, all early tube-mills were of the trunnion type; then came the tire type, with large discharge opening; and now we witness the Chalmers & Williams idea of inserting lifters behind perforated liner plates at the discharge end of the tube, virtually giving a discharge area of the whole diameter of the tube-mill.

In determining proper tube-milling conditions, it is one thing to have a single tube in a plant and be able to vary the system with facility, and quite another to have 10, 12 of 14 tubes without equal facility in varying conditions. In the latter case it is usually necessary to decide upon a system and then carry it out over a period of a month or more and judge the average results. We believe that this method is likely to give more reliable information, as the experiment is subject to true working conditions.

It is usually true that a pulp must contain 38 per cent moisture in order to "get in through" the tube, or to "make the tube handle it," but not necessarily grind it to the required degree of fineness. Under such conditions we discharge the pulp to a classifier so that the unground portion may be returned to the tube-mill, and this is done because more work is demanded of the tube-mill than it can do under the conditions prescribed. In this respect the tube-mill is to be compared to a launder transporting pulp. If it is set practically level, as in the small-discharge-opening type, the more ore it has to handle, the more moisture must be supplied to transport the ore. The greater the inclination, or difference in fall between feed and discharge, the more ore can be passed as a thick pulp, or, in other words, the percentage of moisture required to carry it can be reduced.

Duty of the Tube-Mill

It is a perfectly legitimate subject for debate whether the load going to the tube-mill should be in excess of the tube's capacity for grinding to the requisite degree of fineness, necessitating the return of a part of the pulp for regrinding, or be so adjusted that all of the required grinding is done in one passage of the pulp through the tube. If we are depending on the tube-mill to act as part of the agitation system, we may be compelled to return part of the pulp, but there are more economical agitators than tube-mills. If we can obtain proper grinding with one passage of the pulp through the tube, and also secure some agitation and dissolution of metal at the same time, we can well afford to build the subsequent agitators a little larger to secure dissolution of the metal that would have taken place in the tube-mill if we had returned part of the pulp to it.

The use of a closed circuit in tube-milling has become general practice, and this feature is closely related to the custom of grinding in 38 per cent moisture, for under no conditions will pulp of that moisture content pass through a tube-mill and be properly ground for all--sliming. At the same time we believe that there is no fixed and unalterable reason for returning part of the pulp to the tube-mill. It is the custom; just as it is custom, also, to use 38 per cent moisture. The advocates of this practice claim that if thicker pulp be fed to a tube-mill the machine will become "constipated" and will be unable to handle sufficient tonnage, and so for mechanical reasons it is necessary that the pulp be more dilute. As a matter of fact, this claim tells us exactly what is the matter with tube-mills of small discharge openings. It is admitted that such mills will not grind a sufficient tonnage of low-moisture pulp, and so we dilute it and circulate it through and through the mill until it is sufficiently ground.

An Experiment with Graded Pulps

A simple experiment can be performed that will give some light on what takes place in a tube-mill. Take battery sand practically free from slime as it comes from the discharge of a classifier, and screen it into a number of sizes at intervals of 10 points between 10-mesh and 150-mesh. With each size make a pulp containing 38 per cent moisture, and by agitation of some kind keep the solids in suspension so that the pulp shall be of uniform consistency throughout. Then, commencing with the coarsest grade, take a sample of each pulp on a spatula. A certain quantity of the coarsest grade can be raised and retained on the spatula. Of the succeeding sizes less and less can be raised until, in the case of the 150-mesh pulp, scarcely any can be secured because the accompanying moisture affords sufficient carrying medium to keep the solids in suspension. Or, if each of the pulps were to be dumped on a flat surface, we would find that almost all of the coarsest grade

would remain on the plate. There would be successively smaller quantities of the finer grades, and as we approached 150-mesh we would find more and more of the ore carried away in suspension, even with 38 per cent moisture.

We believe that this experiment indicates what occurs in a tube-mill. With the same percentage of moisture, finer sizes of sand are kept in suspension among the pebbles; and even though the whole mass of pebbles and pulp be rolling and grinding, the finer sands are still in suspension and sluicing around in the voids. The coarser sands are picked up by the pebbles and remain on their surfaces because the accompanying moisture is not sufficient to keep them in suspension. They are then in favorable position to be caught between pebbles and receive the requisite amount of grinding. We think that the pulp should be thick enough to permit the sand particles to cling to the pebbles as they rise with the mill. When the pulp is so thin that no particles cling to the pebbles, poor work is being done, and only the coarse sand is being satisfactorily ground.

It is readily seen that such thick pulp will not flow through a tube-mill that has feed and discharge openings at practically the same level; but it will flow when the discharge is lower than the feed, according to the difference in levels. Tube-mills of small discharge opening were responsible for the standard of 38 per cent moisture; and, in turn, adherence to that standard is responsible for the present tendency toward shortening tube-mills, from 20 feet and more, to 16 feet. With 38 per cent. moisture it is only of the coarser sands that the due proportion is ground, and that grinding takes place near the feed end of the mill. Then the remaining length of a long tube gives little service as a grinder and acts mainly as an agitator; therefore we shorten the tube, classify the ground pulp and return the over-size in the hope that it also will be duly ground in its next passage through the mill.

Diameter is an important factor in tube-mill design, but it is not "the whole thing," and increased diameter has the disadvantage of requiring more power for starting the mill. There is a tendency at present to regard sixteen feet as the most desirable length, on the assumption that practically no grinding is done beyond this point, making additional length useless. Some operators are inclined to believe that this is a mistaken idea, and that with thick pulps, or low moisture content, and a low discharge level, longer mills can be made to do satisfactory work. There is an advantage in using large units, but there is a limit to the practicable diameter, and greater capacity can then be had only by increasing the length.

Cones Versus Drag Classifiers

At one time is was customary to use cones for thickening tube-mill feed; but these devices gave trouble from the beginning, and only by unremitting care and attention could they be made to furnish pulp even as thick as 38 per cent moisture. We believe, however, that as drag classifiers displace cones, and operators have thicker pulps to experiment with, they will regard them as more desirable. As tire-type mills come into greater use, the advantage of quicker discharge will be observed; and those who have condemned the long tube-mills will try discharging with the lifter device over the whole diameter of the tube, and will find that the long mills will grind a larger tonnage than the shorter ones.

Fresh battery sand is easier to grind to slime than is returned sand that passed through the tube-mill and classifier. The former is sharp and angular; the latter is rounded. The former can be more readily dewatered than the latter, and will be more readily picked up by the pebbles in the mill. This can be demonstrated practically by comparing the work of tube-mills on sand from old tailing dumps and fresh battery sand from the same ore.

Effect of Size of Feed on Capacity

It has been observed that some operators deceive themselves as to the net work their tube-mills are doing. If they are treating 100 tons of ore per day, and the pulp going to the treatment vats contains 80 per cent minus 200-mesh, they assume that the tube-mills are grinding 80 tons per day, forgetting that with 16-mesh screens on the battery some 38 to 40 tons was already ground to 200-mesh before passing to the tubes, so that the latter are really grinding but 40 to 42 tons to the required mesh. In this connection we recall a neighboring operator who had 14 tube-mills under his direction, and had always estimated their work at 40 odd tons daily. On properly revising his estimates he found the figure reduced to about 28 tons daily. Feeling that the tube-mills were not doing as much as they should, he endeavored to improve the service. By loading the mills with additional pebbles, feeding the thickest pulp his launders would carry, and substituting 6-mesh screens on the batteries for 16-mesh, he brought the tonnage up from 650 to 1000 tons daily and still had 80 per cent minus 200-mesh solids in his final pulp. This mill follows the practice of open circuit; the pulp does not return to classifiers after passing through the tubes, but flows through a revolving trommel that removes any coarse sand that may accidentally occur in the pulp. The trommel has a 16-mesh screen.

A personal experience may be cited. We had 200 stamps, cone classifiers and thickeners, two tube-mills 5 ft. by 30 ft. and seven tube-mills 4 ft. by 22 ft. The ground pulp was again classified in cones. Following the dictum that the finer the sand going to the tubes the better the product, we used 35 and 40-mesh screens on the batteries, yielding a product containing about 60 per cent minus 200-mesh solids. From 730 to 750 tons could be treated, giving a final pulp of 80 per cent minus 200-mesh. By substituting 25-mesh screens on 100 stamps and 30 or 35-mesh on the other hundred, we were enabled to raise the tonnage from 830 to 850 tons, but this was the most we could get through the tube-mills. With cone thickeners we had to give constant attention to keep the moisture down to 38 per cent.

We then hung up 100 stamps, put 8 and 10-mesh screens on the remaining hundred, rearranged and improved the cone system of classification and thickening and added three tube-mills 5 ft. by 24 ft. This system enabled us to increase capacity to 1050 tons daily; while battery, crusher and conveyor costs that used to total 35 cents went down to 17 cents.

Some of the tube-mills received battery pulp only; others received a mixture of battery pulp and oversize returned from classifiers; and still others received only return feed. The last was itself classified or graded by the arrangement of the distributing box at the top of the elevator, so that some mills received fine returned sand and others coarse. We had continuous opportunity to observe the difference in grinding various sizes of sand. Coarse sand dewaters easily and grinds better in the tube mill; fine sand is difficult to dewater in cones, and is harder to grind. With coarse feeds we could get lower moisture, greater tonnage and better ground pulp; with the finer feeds it was almost impossible to get low moisture, the tonnage was reduced, and the product never contained as much minus 200-mesh solids as was secured from the coarser feeds.

Grinding Oxidized and Sulphide Ores

Our mill ore consisted of 950 tons of yellow, oxidized ore, assaying about $7 per ton, and 100 tons of blue,

sulphide ore, assaying about $30 per ton. There was never much difference between the mine and mill superintendents regarding the tonnage or value of the yellow ore; but there was a continual difference between them as to the blue ore, as this factor entered strongly into the calculations at the end of the month. So we can safely assume that the figures for tonnage of blue ore, as agreed upon by the superintendents and given herewith, are correct.

Formerly the two classes of ore were mixed in the main bin, but on account of the more refractory character of the blue ore it was decided to give each separate treatment. Ten stamps were set aside for blue ore, and a special bin provided. Separate classifying and thickening cones also were added. Later a drag classifier was substituted for the cones. The tube-mill was 4 ft by 22 ft. and had a discharge opening about 18 in. in diameter, being of the tire type.

Extensive experiments were conducted on kind and size of pebble load, and on moisture content of pulp, each experiment being under way for a number of days with the regular attendants on shift. Battery screens were 7, 8, 10 or 12-mesh and were varied to give the desired tonnages under different conditions.

With iron pebbles or grinders, cast-iron ovals or old bolts cut into five-inch lenghts, it was possible to grind 120 tons of blue ore daily and get a final pulp containing from 86 to 88 per cent minus 200-mesh. The moisture was carried as low as 25 per cent, though at this consistency the pulp was really too thick to work through the mill, and only about 100 tons could be handled. At 28 to 29 per cent moisture, however, 120 tons could be treated—that is, a total of 120 tons through stamps and tube-mill. From 30 to 35 per cent minus 200-mesh solids was produced in the batteries, leaving only about 70 tons actually ground to minus 200-mesh in the tube-mill. The power requirement under these conditions was about 95 hp., and as only a 75-hp. motor was available, a run of a few days only was possible.

With a mixture of iron grinders and imported pebbles, or using mine rock for pebbles, the horse-power was reduced to 80 or 85, and the total tonnage treated to 100, still obtaining a final pulp with over 85 per cent minus 200-mesh solids.

The final conclusion was to treat 80 to 85 tons of blue ore daily, using mainly mine rock for grinders, with a small daily addition of imported pebbles. The moisture was maintained at 31 to 32 per cent.

Summary and Comparison of Results

While using 200 stamps with 25 and 35-mesh screens on the batteries, from 50 to 55 per cent of the battery pulp was minus 200-mesh, and the final tube-mill pulp contained 80 per cent minus 200-mesh. Under these conditions each of nine tube-mills ground on an average 25 tons to minus 200-mesh. Since using only 100 stamps, with 8 to 10-mesh screen on the batteries, giving a battery pulp containing only 30 to 33 per cent minus 200-mesh, each of twelve tube-mills averages 42 tons net. Drag classifiers have now been installed throughout the mill and the cones are on the scrap heap, as also is 38 (and so many decimals) per cent moisture for tube-mill feed.

Of these tube-mills, four were trunnion type with small discharge openings. There were tire type with about 18-in. discharge openings. Three were two pairs of 4 ft.. by 22 ft.. tubes, each pair comprising one trunnion type and one tire type. There was one pair of trunnion type only. The remaining mills, two 5 ft. by 30 ft., and one 4 ft. by 22 ft., all were of tire type with 18-in. discharge openings. With the first two pairs mentioned, it was quite convenient to compare the work of each type, and it was observed that the trunnion type never gave as good results in either quantity or quality as did the tire type.

Effect of Speed in Grinding

Grinding in tube-mills is done by the pebbles sliding or rubbing over or against one another, and not by falling against each other. Very little grinding is done between pebbles and the tube-mill liner. The revolution of the mill should be so regulated that centrifugal force will raise the load high enough to permit the pebbles to slide over each other, but it should never be sufficient to permit the pebbles to fall through clear space. The proper mean speed probably results in letting some of the upper pebbles fall clear while the main body slides. This result can be obtained better through centrifugal force than by liners adapted to carry the whole load up.

Irregular-shaped mine rock used for grinding probably does little work until it has been ground to round or oval shape, and tube-mill power for this purpose is expensive. The same amount of power expended on grinding with round pebbles would accomplish much useful work. Feeding pebbles through the scoop is slow work, and pebbles that miss the scoop and fall in the feed-box may cause the breaking of the scoop. On removing the door of a tube-mill we usually find the pebbles evenly arranged throughout the mill, according to size, regardless of the method of feeding them.

When a tube-mill is grinding its full load a distinct rise in temperature of the shell can be noted. If the pebble load is light, or the moisture content of the pulp so high that the increased temperature is not apparent, the mill is not doing the work it can be made to do.

Relining a Tube-Mill

With El Oro liners a tube-mill can be relined in 14 to 16 hours. The new liners should be piled near the tube on the previous day. At 5 A. M. stop the mill, take off the man-hole plates and start the mill again allowing the pebbles to discharge on the floor, then stop the mill again, loosen the bolts holding the liners, taking the nuts off and driving the bolts to the inside, where they are gathered up. Now start the mill again, and inside of half an hour the plates will have fallen and almost all of them will be lying on the floor beneath the mill. The new plates and pebbles can be replaced, and the mill be in operation again by 8 P. M.

Cupels of cupellation furnaces are now commonly made of cement. One of the reverberatory type in Japan handles 1.5 tons daily and requires renewing after 5 tons have been treated. Iron is introduced on the hearth to take up any sulphur present and the slag is drawn out of the working doors.

A device for preventing briquets of flue dust breaking up and returning to dust in the furnace has been patented in Japan. The briquets, while moist are forced in small cast-iron pockets on an endless chain and are passed under a stream of molten matte. The matte consolidates the briquets and renders them resistant to the wear and tear of the descending charge in the furnace stack.

In factories where space is valuable electric motors, even up to 50-h. p., are attached to the wall or suspended from the ceiling. The suspended arrangement is most satisfactory. This motor is mounted upon heavy timbers and these are hung from the floor beams above by means of one inch bolts. Arranged in this way the motor takes up no room which would be available for other purposes, and it may be placed at any convenient distance from the line shaft.

Early History of Sombrerete, Zacatecas.

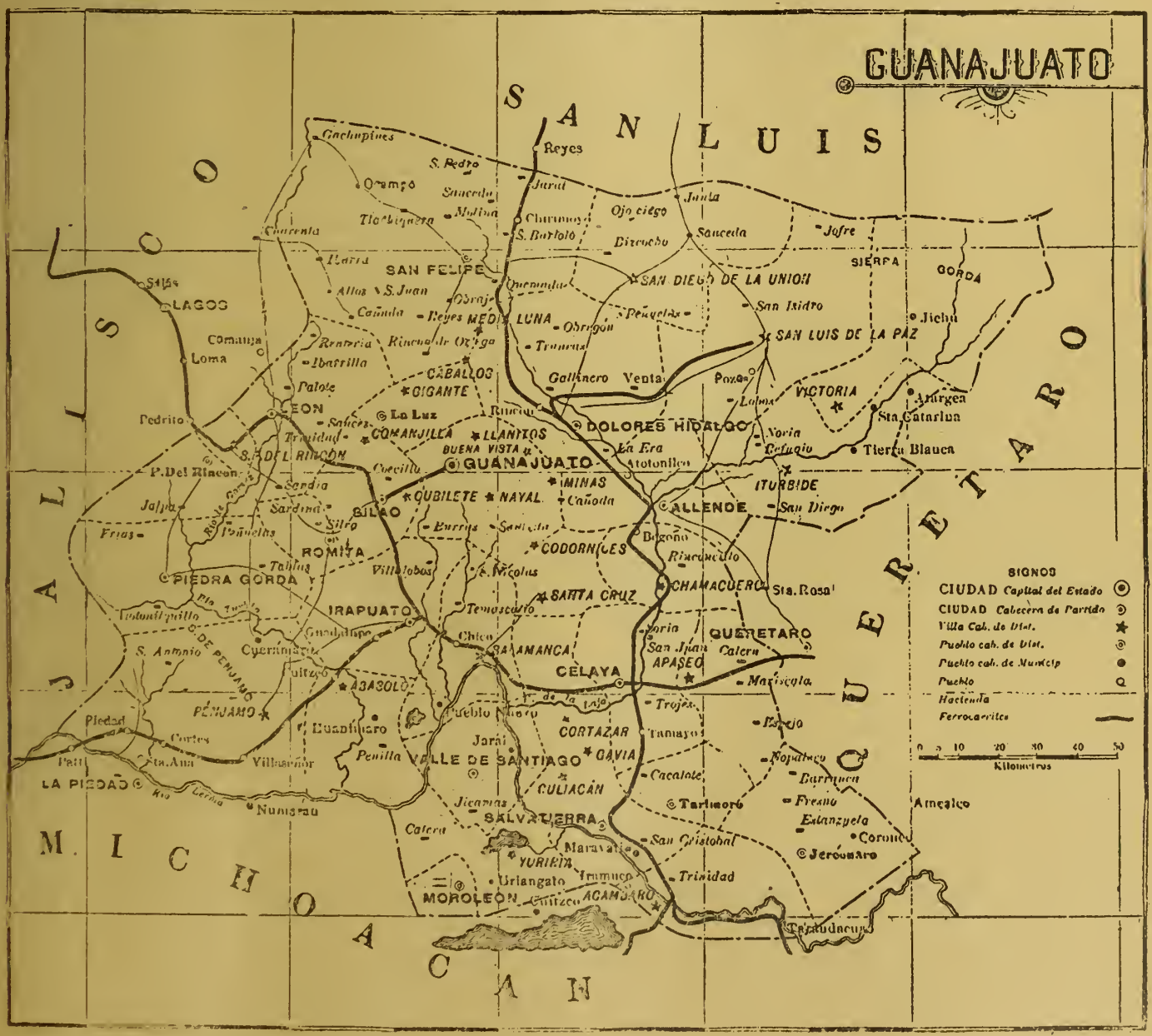
From "Historical Sketch of the Sombrerete Mines," by H. L. Heldt.

Sombrerete is famous for its two big fissure veins called the Veta Negra and Pabellón, which have strike of about northwest and southeast and dip to the south. The Veta Negra is located to the south of the Pabellón, and on account of a difference in dip, they come together in depth. The Pabellón is said to have been discovered at what is now a big outcrop working called Arenillas, located at about the center of the property; and south of this, Los Tocayos shaft was located in March 1897, and was calculated to cut the Veta Negra and Pabellón veins at the point where they join at a depth of about 600 meters.

The Pabellón outcrops for a distance of about three kilometers, but only the western half was known as Pabellón, the workings on the eastern half always having been called Minas de la Cañada, and where the Cañada ends, Minas de la Cumbre.

East of where the Los Tocayos shaft is located, the Veta Negra is covered by an overflow of rhyolite, and for that reason was not prospected in olden times.

Both veins cut through precambrian slate at about right angles to the bedding plane, but the Pabellón crops out through some unconformable limestone in one place, and on the eastern end of the property the rhyolite nearly comes up to the outcrop of the Pabellón, and for that reason, I suppose, the veins have been described as irregular deposits in limestone and contact deposits.



Map of Guanajuato.

Early History

Historians do not agree on the date of the discovery of the mines in Sombrerete, and it is impossible to say if this was done by Ginés Vásquez del Mercado in 1552, when he found the iron mountain in Durango; by Ybarra and Martín Pérez in 1548; by Juan de

Tolosa in 1555; or by some of the captains of Guzmán in 1530.

There seems to be no doubt that the camp was established and the first church built in the Cañada and that Sombrerete increased at such a rate that the people soon had to look for more room.

In 1567 the convent San Mateo with its church was built on what is now called Calle de Tacuba, and the principal houses were built on the Plaza called Plazuela de los Donceles. Sombrerete continued to grow, and a few years later a meeting was held by the inhabitants of the camp and the ranchers of the neighborhood, at which forty married men and thirty single men were present. At this meeting it was decided to ask the Audencia de Guadalajara to make the camp a village; and for this purpose Alonso de Yerena was sent to Guadalajara, with power of attorney, where he completed his mission successfully in November 1570. The new village was named Villa de Yerena, Real y Minas de Sombrerete.

During the first 100 years Sombrerete had its ups and downs, and some mining was done in the district, but as all the silver was taken to Zacatecas for assay and payment of taxes there is no record of the amount.

Zacatecas was the head of a large district including Sombrerete, Ojocaliente, Asientos, Fresnillo , and many other places, and as high as 250,000 marcos of silver are said to have been received there in some years.

In 1587 Padre Diego de Ordóñez, famous for his learning, piety, and many good deeds, died in Sombrerete at the age of 117 years. During the last seven years of his life he only left his cell in the San Mateo convent to preach in the church every Sunday, and in his last sermon he predicted the decline of the camp, which is said to have come to pass.

Miner and Saint

In the same year Juan de Angulo came from Spain to work for his uncle Juan de Angulo in his mines in Sombrerete; but he soon tired of this and went to work for Juan de Guerra, the owner of the ranch called Cedros. He stayed at Cedros for a number of years exploring mines and returned to Sombrerete with a large fortune. On his return he found the San Mateo convent in bad condition, and at his own expensse built a new convent.

In 1627 he was admitted to the San Francisco convent in Zacatecas, where he performed many extraordinary miracles, and where he died honored and mourned by all on the 16th. of December 1644. Shortly before his death he predicted new discoveries of ore in Zacatecas, Sombrerete and Fresnillo.

In 1727, on moving his body to a new resting place it was found as perfect as on the day he died, and this fact was certified to by the proper authorities. This coming to the ears of the King of Spain, the Bishop of Guadalajara was sent to examine witnesses regarding the miracles and investigate the state of the body for the purpose of declaring him a Saint, and he found everything told the King to be true. The Bishop returned to Guadalajara and died a couple of days later and the matter was forgotten, or is in suspense.

The First Company

In 1677 a company was organized by Capt. Francisco Costilla y Espinosa, Mathías López de Carrasquillo, and Joseph de la Peña Durán to work the mine Pabellón, near the place later known as San Juan Bautista de Arenillas, and as they were prosperous from the start, and as others were doing well, Sombrerete was made the head of a large district, and from 1681 to 1690 inclusive, 1,281,839 marcos of silver were presented for assay and payment of taxes, which at $8.00 per marco amounted to $10,254,712.

During the year 1691 the production continued at a high point and amounted to 124,629 marcos and from 1691 to 1700 inclusive, the total amount presented was 648,335 marcos. This was brought from Chalchihuites, Nuestra Señora de las Nieves, Veta de Reyes, Real de los Frailes, San Pedro de Vacas, Real de Copala, Santa Rosa de Cosigüeriachi, Real de Topia, San Francisco del Nombre de Dios, San Miguel de Theul, Mazapil, Guanaceví, Rosario, Parral, Urique, Cianori, San Antonio de Cuencamé and Pánuco, and a few marcos were presented by a silversmith which had been worked into ornaments for people from the Villa de la Purificación, Real y Minas del Fresnillo, Bonanza and Real de Gamón.

During this time the tax on silver amounted to 1 and 10 per cent with the exception of the silver presented by ore buyers, which paid 1 and 20 per cent. On account of this large difference the silver presented by ore buyers did not amount to 100 marcos per year.

On the 18th. of June 1700, orders were received from the Conde de Moctezuma to collect an extra tax of one real per marco on all the silver intended for coinage.

The mercury and saltierra used in treating the ores, were handled exclusively by the Royal Treasurer, and the saltierra cost 50 cents per fanega. The quicksilver cost nearly 100 pesos for each 100 lb. and in addition the buyer had to register 100 marcos of silver for each 100 lb. of quicksilver delivered to him.

From 1701 to 1710, the production amounted to 295,295 marcos and the greater part of this came from points outside of Sombrerete.

During the above 30 years the principal producers were General Antonio de la Campa Cos, Capt. Francisco Costillo y Espinosa, Mathías López de Carrasquillo, Joseph de la Peña Durán, Gen. Francisco Fuertes de Sierra, Gen. Francisco Rubín de Zelis, Gen. Domingo Alonso de Bustamante, Capt. Francisco Moreno de Calahorra, Bachiller Miguel Gómez de la Vega, Capt. Miguel de Ontiveros, Capt. Gregorio Mathías de Mendiola, Capt. Bartolomé García Ramón, Capt. Joseph de Mier y Noriega, and amongst the smaller producers were María de la Torre, Minera, Sergeantmayor Andrés Moro, Bachiller Ventura Xaques, Gregorio de Cosío, Capt. Pedro de Umaran, Sergeant Juan de Saldaña, Nicolás de Apspur, Nicolás de Medina, Juan de Hendris, Domingo Tagle Bracho of Chalchihuites, Capt. Pedro de la Puebla, Caballero de la orden de Calatrava; Gen. Pedro de la Campa Cos, Luis Asco, and many others.

Early Mining Magnates

Francisco Costilla died in 1694 and his son Lic. Andrés Costilla came from Guadalajara to settle up his estate. A few years before his death his daughter María Velázquez y Espinosa married judge Antonio Vidal, Joseph de Abarca, and as it was against the law for a Judge to marry in his district, the father got a general permission from the King of Spain sanctioning the marriage; this permission cost him $3,850. At about the same time he, and his wife Antonia Velázquez gave $40,000 to their son as his patrimony.

Peña Durán died in 1706 and López Carrasquillo in 1708, and both kept their smelters going to the day of their death. During the last few years the production did not amount to very much. The hacienda belonging to López Carrasquillo passed into the hands of Francisco Díaz de Casaferniza in payment of debts and Francisco Núñez took over the one belonging to Peña Durán for the same reason. Durán owned half of the mine Candelaria worth $300, and was married to

one of the daughters of María de la Torre. López Carrasquillo left his estate, consisting mostly of pawn-tickets to his second wife, and he did not leave anything to his only child Gerónima Carrasquillo, whom he had with a "China Esclava" named María de la Torre, as she had started suit against him to get money promised her when he was prosperous.

Joseph de Mier was manager for the Marqués del Valle del Súchil who was working the San Amador and Tajo de Ibarra in La Noria.

Gen. Antonio de la Campa Cos abandoned his hacienda on May 18 1701, and retired to his ranch San Sebastián of which the foundations can still be seen near Santa Catarina.

The Condado of San Mateo de Valparaíso, consisting of over 100 sitios, was granted to Don Fernando in consideration of the sum of 6 pesos.

Curious Old Contracts

In 1690 Gen. Francisco Fuertes de Sierra died and left an state worth about $40,000. He was the owner of one third of the mine La Cumbre worth $3,200, and one third of the mine San José valued at $400.

In 1690 Gregorio Mendiola, merchant in Chalchihuites, bought at auction, the income from the tax called alcabalas for two years and for the right to collect this in Chalchihuites he paid $120 per year and in Nombre de Dios $150. For the same length of time Gen. Alonso de Leiva y Sasi, Gen. Juan Guijarro, Gen. Juan Medrano and Joseph Alcaide got the contract to furnish all meat to Sombrerete for which they paid $1,000 per year, and in addition had to furnish the bulls for two bullfights, to deliver a sheep and a quarter of beef each week to each of the convents of San Francisco and Santo Domingo, and a quarter of beef to prisoners. The price at which they contracted to furnish the meat was; 1 young steer on foot $4.00; 12 lbs. of meat one real; a quarter of beef 6 reales; 1 sheep on foot 12 reales; a quarter mutton 3 reales and a sheep skin 2 reales.

Gen. Pedro de la Campa Cos was manager of the Salinas del Peñón Blanco and transferred his rights to Capt. Pedro de la Puebla. He also owned a number of mines in this district which he transferred to his nephew Gen. Antonio de la Campa Cos, among them the Santa Rita in Nieves and a mine called de Masias adjoining the Pabellón, which was exchanged later for a barra in the Pabellón to prevent lawsuits and damages in the Pabellón.

Gen. Toribio González de Escalante was the owner of an hacienda in the Puesto de Sain, which he mortgaged to Francisco Costilla for $6,000 in 1691, and this mortgage was transferred to a church in Sombrerete shortly afterwards.

Sergeant Juan de Saldaña bought the ranch called Proaño, located about two leguas from Sombrerete in the direction of the llanos de San Miguel, in a valley where there was a small lake and a number of small springs on the edge of a wood, which had been granted to Alonso and Francisco Proaño in 1574, along with the sitios called Alamos and Organos. His descendants were selling wood and charcoal from here as late as 1744, the year the church of the Terceraorden was under construction.

A Miner Soldier

Capt. Miguel de Ontiveros of Chalchihuites had a great lawsuit with the Tlaxcaltecas of San Andrés for the possession of the ranch called Chupaderos, which adjoined the ranch belonging to Miguel Gómez de la Vega, and the land of the people of Tonalán, but after some years of fighting the Tlaxcaltecas proved that this land had been given to their fathers, as defenders of the frontiers against the barbarous Indians, under a special charter of the King in the year 1591, and they were put in possession on April 30 1679.

During the year 1702 the production was 15,000 marcos, and during 1707, 25,000 marcos above the average production from 1701 to 1710, and all of it was delivered by Gregorio Mendiola of Chalchihuites, who is famous both as a miner and soldier.

He led the second expedition against the Nayaritas in 1715, under the name of General Don Gregorio Mathías de Mendiola, and when he first started mining he found the ore in a yellow sticky gangue, and this yellow clay he used for making adobes out of which he built his houses and smelters. Some years afterwards he found that this yellow clay was richer in silver than the ore he had been treating, and he went to work and smelted his houses and smelters with excellent result.

Gregorio Mendiola was the owner of the ranches San Antonio, Ranchos, Hornillos, Concepción, Saucillo and others, which Juan Pablo Robres y Mendiola inherited.

A great many priests presented silver for the payment of taxes, and amongst them the Rev. Father Fray Diego de Fraga registered 128 marcos, which had been given to him in the Real de los Frailes, and Fray Nicolás Alvarez of the order of Santo Domingo paid taxes on 119 marcos which had been given him in Cusihuiriachic and Urique. Fray Vicente Naneio of the order of Santo Domingo, beggar for the convent of Nuestra Señora de la Piedad of the City of Mexico, paid taxes on 165 marcos, which had been given him in Sombrerete.

Use and Care of Wire Rope.

A wire rope is not a mere piece of steel, but, in reality, is an intricate machine with all parts moving parts. Arthur Prill, in the Coal and Coke Operator, shows that in order to get most work and wear out of a rope requires a high degree of ability and much thought. He says:

If you are a user of wire rope it will pay you to study your needs carefully. If you order an iron rope when the service really calls for a plow-steel grade you'll learn something, the disadvantage of the experience being its expensiveness. If you bought a good quality of rope suited to your needs six months ago, and now order another lot of the same, and find that it's ready for the scrap heap in half the time, look at your sheaves—are they still hung as true as they were? Look after your new engineer—does he inspect and grease as regularly as his predecessor did?

Let's look into the special requirements of your situation. Remembering that the man who sells an article usually knows more about it than the buyer, give him a chance to use his knowledge to your profit; that's his profit, too. You have presumably selected a source of supply that offers you ample stock, backed by good results as vouched for by competent judges and proved by the re-orders of important firms in your own line. Now, repose some confidence in that supply house and the judgment of its consulting engineer.

Tell him frankly what goods, if any, you have used, and with what success. How much has wire-rope transportation cost you in the past? How are you employing it, for what distance, and for how many hours per twenty-four? What power do you use, and at what speed? What are the physical circumstances; will the rope be exposed to much moisture, to deleterious gases, or to sudden changes of speed while undergoing reversed strains? You'll be surprised to learn how clear an insight into your needs the consulting engineer will show when once you fairly consult him.

As you are trying a new brand of wire-rope, it is evident that you are either dissatisfied with previous results or are putting a new plant into action; hence you can have no time-tried adviser. It is certainly for you to decide on what you want; but you may as well get the benefit of the experience of a man who, perhaps, handles as may feet of new rope a day as you see in a year.

Each Case a Special Case

If you are a small customer and do not feel that you have the right to ask for special consideration, the house that is proud of the rope it makes or sells can show you the test-records taken during its manufacture, not merely of the piece you buy to-day, but of the exact quality of any reel they have sold years ago. If you consume large quantities, the firm will refuse no reasonable basis of tests for the quality you demand.

When you necessarily subject you cables to severe stresses under unfavourable conditions, when human life often or always hangs on the end, you need something not merely good, but absolutely reliable.

For ordinary work, requiring a pliable rope that shall pass over reasonably large sheaves, a six-strand rope, nineteen wires to the strand, all centred around a hemp core, will most likely be satisfactory. This is a standard construction rope, and is furnished by most makers in different grades, such as iron, crucible-steel, plow-steel, and extra quality steels.

The last, usually made from drawn wires having a tensible strength of 220,000 to 280,000 lb. per square inch of sectional area, should be ordered where greatest strength and hardest service are demanded. It is used on heavy derricks, in structural steel and bridge erection, for dredges, steam shovels, and rapid mine-hoists.

Haulage rope, to be used over small drums and curves, may to advantage be specified of the six-strand, nineteen wire to the strand with hemp-rope core type. Similar construction of rope, but made of iron, may be demanded for economical transmission of power when the pulleys are small. Both for power transmission and for haulage purposes, where drums and pulleys are of ample diameter, seven wires to the strand gives excellent results, as the coarse wires used in this construction resist abrasion and wear longer than finer wires.

Remember that in supporting a heavy load the size of the wheel or sheave should be proportioned in accordance with the size of the individual wires composing the rope. In no case may wire be safely bent over a wheel less than 1,000 times the diameter of the wire. This will prove quite a factor in the number of times which you must pull out your cheque-book when you write to your supply house.

An extremely flexible rope for hand ropes on elevators, steering rope on vessels, and other installations where no severe strains are excepted and no danger of abrasion exists, is made of six ropes, each possessing six strands and a hemp centre, all laid around a large hemp centre, and formed of 252 wires in all, and known as tiller rope.

Automatic steam towing machines for lake, river, and sea towing must be supplied with hawsers of the greatest obtainable strength and durability; flexibility is in this service also essential. Such demands are met by special deep-sea towing hawsers of galvanised steel, which should be so constructed that 50 per cent. or more of the wires in the strands are on the inside, which permits of considerable wear on the outside layer before the inner wires are weakened.

One reason why your supplier's judgment should be made use of is that inexperienced buyers err as often taking a rope too large in diameter as by taking one that is too small for the service. Standing or guy ropes may be ordered with several steel wires twisted into a single strand; a ⅝-in. rope of this class has a breaking strength of, approximately, 14,000 lb., which is considerably stronger than hemp-core rope of the same diameter; of course, the few coarse wires prevent flexibility.

Size Required

In calculating the size of rope necessary to meet unusual stresses, there is nothing gained by allowing a larger factor of safety than conditions actually demand. Under most circumstances it is better to make use of wires of high tensile strength than of large cables constructed of inferior and cheaper material, demanding great weigh of rope. At the some time it should be remembered that wire of high ultimate stress is more liable than any other to become brittle; it is, therefore, subject to risk of failure under conditions of frequent reversal of stress.

The more deeply we study the subject of wire ropes the more certain does it become that every installation requires special thought by someome of wide experience. Even after the rope has been correctly selected and properly placed, the engineer handling

the levers of the motive power can often with advantage be instructed of the fact that when the speed of acceleration is high the stress upon the ropes may be increased during the acceleration period to 50 per cent. above that due to the dead load, and that when, through carelessness, 6 to 12 in. of slack is jerked up at the start, a stress three times that due to a normal load is incurred.

Ropes rarely or never fail from direct tensile stress. The trouble has usually been long in reaching the acute stage. General deterioration of wire ropes is brought on by entrance of moisture, oxidation, brittleness, contact with deleterious gases or waters, and last but not least, carelessness. In this connection the best advice is: Frequent inspection and regular oiling. If this is not practical recapping and examination of the interior of the length cut off will give a sufficient idea of any corrosion to be found within; for the portion cut off is that which was most subject to varying strains. The latter tend to open up the strands and permit entrance of moisture, which is the most dangerous factor in inducing corrosion. Hence, if the cut-off length presents a sound interior, the rest of the rope may generally be regarded as in like condition. At the same time the whole length of the cable should be subjected to careful exterior examination.

"Proper lubrication" is the key with which to lock the stable before the horse is stolen. The condition of the ideal rope from which perfect service can be expected is that every strand, every wire, shall be maintained free from any substance which could attack its integrity; a lubricant which will form a coating around each wire is requisite; the application must be made with care to obtain desired result. Particularly is good lubrication necessary for ropes which are subject to periodic idleness. Such periods otherwise develop into active invitation to rust.

At the same time, more harm than good may be accomplished by a bad dressing; some cheap lubricants hasten corrosion and general deterioration. Particular care should be taken to avoid tallow, resin, ordinary anti-friction grease, Stockholm tar, or any grease that contains acid. A good rope dressing is usually composed of plumbago or graphite mixed with linseed oil, vaseline, or palm or other vegetable oils. This lubricant must not only thoroughly penetrate the rope, to obtain which end it is often applied in a heated state, but it must afterward remain sufficiently soft not to so harden in the atmosphere as to accumulate on the sheaves. The latter condition is likely to lead to a throwing off of the rope from the gummed-up sheave.

Tests have shown that of two exactly similar lengths of rope run over a 24-in. pulley, one, left unoiled, passed over the pulley 74,000 times; the other, lubricated, passed over the same pulley, 386,000 times.

The above points present a mere hint of the subject of wire-rope and its treatment. The chemistry of its steels would alone make an interesting volume The practical lessons to be derived from years of use and supervision of wire-rope installations could be gathered to equal advantage from many an humble engineer as well as from managers of extended tramway systems.

Mines in Japan are not generally worked by stock companies, but are mostly family properties handed down to the present owners from their ancestors. Only in a few, rare cases in recent years has the aid of foreign capital been called in. The shares of only one company are dealt in on the stock exchange. Mines are worked like other industrial enterprises, and owing to the abundance of cheap labor, exceedingly low grade ores are worked at a profit.

Secondary Enrichment in Gold Veins.

In a recent article in Mining Science, E. L. Mann calls attention to the importance and apparent neglect of secondary enrichment as follows:

There is one subject pertaining to practical mining which should be of great interest to those who prospect for and develop new properties; that is the role which chemical reaction and erosion play in relation to secondary enrichment. This subject has been but lightly treated in our time honored text-books, and only lately has it received a limited amount of attention.

It is still held that the richest zone of secondary concentration in gold-bearing veins is at or close to the surface. The reason given for this is that chemical reaction and surface waters have little or no effect on the solubility of the gold. Emmons cites the presence of manganese in veins as a solvent of the gold, but as the majority of the leached outcrops do not contain manganese, some other solvent must be looked for and this can be found in the chemical reaction of the sulphides, which are an almost universal occurrence in gold veins.

The oxidizing of these sulphides in combination with atmospheric waters generates sulphuric acid, which, although extremely slow in its action, dissolves the gold and these enriched solutions filtering downward in the vein, deposit their load on coming in contact with the unaltered sulphides at or close to water level. Not only will the gold which is chemically combined with the sulphides be affected and dissolved, but the gold occurring as isolated particles in the quartz will also be attacked and leached out to a considerable extent. During the time that this occurs climatic conditions must be ideal for the accomplishment of this leaching process; that is warm with just sufficient precipitation to supply the moisture for leaching, but not enough to favor rapid erosion. This may be called the initial stage of surface alteration and when completed, an impoverished or barren outcrop results.

The second stage begins when through terrestrial causes the climate changes. Torrential rains or the thawing of much snow favor rapid erosion, and this, acting on the outcrop, removes the upper barren portion down to the enriched zone, which now becomes the surface. There remains a vein the upper portion of which is the richest, while near water level we find the primary ore to be much lower in value. Therefore it would seem that any vein showing in the quartz on the surface the former presence of sulphides in the from of casts or cavities, but without gold in profitable amount, is very favorable for an enriched zone at

a lower level. Massive, blocky quartz, showing no trace of former mineralization, does not fall under this heading, since secondary enrichment depends on primary mineralization.

Example from Practice

A good case in support of the above contentions came to my notice in Idaho. The outcrop consisted of a white porous quartz resembling scoria without even a stain of iron oxide. The cells in the quartz were perfectly clean, which shows an ideal case of long continued leaching. Assays gave a trace of gold. The vein was tapped by an adit 50 feet below the outcrop. Here the cells in the quartz were partly filled with oxide of iron and the quartz stained heavily. The gold was free but fine flour gold and the ore assayed $21 per ton. Another adit tapped the vein 20 feet above water level and 150 feet below the outcrop. The cells in the quartz here were completely filled with iron oxide; the gold was coarse and free and averaged $45 per ton. The wall rock could not have had any influence in this as it is uniform in composition from the surface to the lowest level.

In my opinion too much stress is laid on outcrop enrichments in gold veins. A miner will cheerfully sink through a barren iron gossan with only a few copper stains to encourage him in the hope of finding rich ore below, but he looks with apprehension on a nearly barren cellular quartz outcrop, even if it is in a known gold-bearing district. If gold can be dissolved slowly by sulphuric acid, then the only factor to be taken into consideration is time, and time in nature is unlimited.

Estimating Arsenic in Ores.

The following method for the estimation of arsenic in ores by Basil G. Dunstan appeared in a recent issue of the Chemist Analyst:

Weigh out from 1 to 5 gm. of ore, add 10 c.c. of tartaric acid solution and 15 c.c. strong nitric acid, cover the beaker and heat until the ore is decomposed, add 20 c.c. 1 : 1 sulphuric acid, cover and boil until all nitric acid is driven off. This is evidenced by a sudden rush of red fume toward the finish. When this occurs heat for half a minute longer. No charring of the tartaric acid should take place. Allow to cool, and dilute to about 50 c.c. with warm water, cool, filter,

To the filtrate add about half a gram of sodium sulphite, and boil down to 50 c.c.; this completely reduces the arsenic and expels all sulphur dioxide.

To the cold solution in the flask add 100 c.c. strong hydrochloric acid, and saturate with sulphureted hydrogen, usually about 5 to 10 minutes. Filter off the precipitated sulphides and wash twice with cold 1 : 1 hydrochloric acid, and twice with cold water.

Wash the precipitated sulphides off the filter paper into a small beaker, decanting back through the filter any excess of water. Dissolve the portion adhering to the filter with the mixture of one part strong ammonia and one part hydrogen peroxide, allowing it to run through into the beaker containing the rest of the precipitate. Boil the solution to effect complete solution and oxidation of the arsenious sulphide, filter if necessary, and boil down to 10 to 20 c.c. Cool, and add 10 c.c. strong ammonia. Cool, and add gradually 5 to 10 c.c. magnesia mixture, stirring continually for about 5 minutes; and allow to stand over night.

The precipitated ammonium magnesium arsenate is filtered off through a previously ignited and weighed alundum filtering crucible, and washed three times with ammonia water (3 parts water to 1 part ammonia). Dry in water oven and ignite over the blowpipe for 10 minutes, cool, and weigh as $Mg_2As_2O_7$.

The tartaric acid solution is made by dissolving 400 gm. tartaric acid in 400 c.c. water, and adding 400 c.c. strong nitric acid.

Magnesia mixture:—Take 110 gm. magnesium chloride and 140 gm. ammonium chloride and dissolve in 1,300 c.c. water.

Rosario, Chih.

Assay of Tin Ores and Concentrates.

Summary of Views on the Pearce-Low Assay.

1. The degree of fineness of the ore must be at least 100 mesh, otherwise a representative sample cannot be obtained.
2. Nickel crucibles are superior to iron ones; the time of reduction is not so long if nickel crucibles are used for fusion. For tailings, fusion in an iron crucible should be avoided; it is desirable to keep the amount of ferrous chloride in the solution as low as possible, particulary when the tin contents is small, otherwise high results are obtained.
3. The amount of hydrochloric acid should be about 125 c.c.
4. The bulk of the solution before reduction should be about 400 cc.
5. The temperature of the tin solution at titration should not be more than 70° F.
6. The strength of the standard solution should not generally be more than 11 gm. of iodine and 20 gm. of potassium iodine per litre, or less than one-third the above strength.
7. Before titration the calcite should have entirely dissolved.
8. Titanium, tungsten and bismuth must be removed by the means already described before titration.
9. Copper and iron should, under special circumstances be removed.
10. Nickel should always be used for reduction.

If these precautions are taken and care is exercised in the fusion and other manipulation, the authors are of opinion that the error in the results obtained should certainly not exceed 2 lb. of black tin per ton with rich ores, and 1½ lb. per ton with 1 0|0 ores.—E. A. Wraight and P. Litherland Teed, Bulletin, I. M. M.

Corrosion of cast-iron pipe can be minimized by surrounding it with lime in the trenches in which it is laid. It is also suggested that the trenches not be covered, as the alternate wetting and trying would be preferable to the constant exposure to moist air, salt and carbonic acid in marshy soil.

Permeability Tests of Gravel Concrete.

At the University of Wisconsin tests are being made to determine the permeability of concrete in water. The test pieces are of Universal Portland Cement, sand, weighing from 104.5 to 112.2 lb. per cubic foot with an absorption of from 0.19 to 0.29 per cent and gravel of 109.3 and 107.3 lb. per cubic foot and 0.63 and 1.4 per cent absorption respectively. The following conclusions were drawn from the tests: None of the concretes tested were absolutely water tight, but the majority of the mixes showed no visible evidence of flow; for most purposes this can be considered water tight.

The visibility of dampness on the bottom increases with the humidity of the air and the non-homogenity of the concrete. The minimum rate of flow for which leakage was indicated was 0.00011 gal per square foot per hour. In tests of nearly all of the properly made mixes of 1:7 proportions, the rate of flow for a 50 hour period was 0.00011 gal per square foot per hour under a pressure of 40 lb. per square inch. A reduction in the rate of flow and a considerable increase in the strength in 1:9 mixes were secured by increasing the fineness of the cement.

Water-tight Mixes

It was possible to obtain a practically water tight concrete of 1:9 proportions under pressures of less than 40 lb. by grading the sand and gravel in accordance with Fuller's curve and using great care in mixing, placing and curing the concrete.

If a proportion must be selected, a 1 : 1½:3 mix is quite impervious. It should be remembered, however, that the volume changes in rich mixes due to alternate wetting and drying are greater than for lean mixtures. Consequently due attention must be given to the provision of expansion joints and reinforcing in structures made of them.

Sufficient water must be used to produce a mushy or medium consistency of the concrete, because dry mixtures cannot be sufficiently compacted in the molds. Although the use of a wet consistency does not materially affect the imperviousness of very rich mixtures such as 1:1½:3; it greatly increases the flow through a lean mix.

For lean mixes made from damp sand it seems best to mix for a period of 1½ to 2 minutes with a mixer run at 30 r. p. m. to secure a thorough mixing of 1:9 concrete. For a rich mix of 1:1½:3, a one minute period seems sufficient. A preliminary period of dry mixing lasting from one to 30 seconds seems desirable.

Premature drying destroys the imperviousness of 1:9 mixes, seriously impairs that of 1:2:4 mixtures and diminishes that of 1:1½:3 mixes. For thin sections 6 or 8 in. thick the curing conditions should be such that a lean concrete should be damp for at least one month and a rich concrete for two weeks. The imperviousness of the concrete increases rapidly during the first month but after that change is not marked. It seems probable that the permeability of lean concrete in a direction normal to the pouring is greater than in the direction of pouring.

"Experience is the best teacher," is a saying the truth of which everybody knows. Unfortunately a great many mining men do not adhere to the text literally, but believe, if they do not say, "Experience is the only teacher," which is an entirely different thing. Everybody must go through the school of hard knocks, of course, but the man who depends entirely on his own experience will not get very for. Technical journals record the experience of others, and he who is wise will make used of them.

Solution of Gold in Cyanide.

Experiments carried out at the research laboratory of one of the largest cyaniding plants in South Africa have given ample proof that gold dissolves in cyanide solution in direct proportion to the area of metallic surface presented. To take the simplest conditions, if a gold particle has a diameter of 1 mm., its volume will be 0.5236 cu. mm., and its area 3.1416 sq. mm. For a sphere of 2 mm. diameter, the corresponding figures are 4.1888 and 12.5660. The ratio of volume to surface in the larger particle is as 1 to 3, while in the smaller it is as 1 to 6. At ½ mm. diameter the ratio becomes 1 to 12, and so on.

The economical limit of size is one to be determined in the light of results. With relatively coarse gold the time of contact must be prolonged to insure high extraction for a large tonnage it pays to instal expensive machinery for fine grinding in order to obtain quick extraction by slime treatment; for a small tonnage leaching would be cheaper. It is purely a question of what pays best, which must be ascertained by experiment.

In general it may be said that gold particles, to be susceptible to economical leaching by cyanide solution, should be smaller than 0.01 in. diameter, or 0.25 millimetre.

Melting Points.

Latest estimations adding to the table of melting points published by the International Committee of Standards are given herewith:—

800 parts silver, 600 parts gold.....	850° C.
400 parts silver, 600 parts gold.....	1020° C.
950 parts gold, 50 parts platinum . .	1100° C.
750 parts gold, 250 parts platinum . .	1220° C.
600 parts gold, 400 parts platinum . .	1320° C.
450 parts gold, 550 parts platinum . .	1420° C
Standard Metals—	
Silver free from oxygen	962° C.
Gold	1064° C.
Platinum	1755° C.

The measurements have been carried out by using thermo-electric pyrometers, as well as resistance pyrometers.

Cleaning a Centrifugal Pump.

At the Johann Deimelsberg mine, in the Werden District, Germany, a centrifugal mine pump. which had to raise 6 c. m. of water per minute to a height of 250 m. worked under considerable disadvantage on account of mud clogging the pump. In order to prevent this deposition, the following plan was adopted:

After the centrifugal pump had been stopped the slush which collected in the pump was drained and clear water substituted; 1½ to 2 liters of mineral oil was added and the pump put in motion and worked in dead water for a few minutes. Water and oil were thus mixed and all the internal parts of the pump wetted with the oily water. After the pump was stopped again, this oily water was allowed to remain inside the pump until it was put in use again. Since this process has been followed regularly, the clogging has ceased and the pump can be used steadily and with very little attention.

According to a recent estimate there are only eleven billions of dollars in gold coin and bullion in the world. Yet the European war is expected to cost eighteen billions during the first year alone.

Functions of the Mining Geologist.

By F. H. Hatch. *

Enough has been said to indicate the dependence of mining on geology; but that this dependence is not universally admitted is evidenced by the prejudice against both the mining geologist and the scientifically trained engineer ocasionally found among mining employers, by whom they are sometimes unfavorably compared with the socalled "practical miner."

Rule of thumb methods, however, in either mine valuation or exploratory and development work can never command success; indeed, the unschooled miner often enough realizes the value of geology and sets about acquiring such a working knowledge of its principles as will enable him to tackle the more prominent tectonic troubles met with in sinking or drifting. But men of this stamp are the exception rather than the rule, and it is clear that other things being equal, the trained man, who brings to mining problems a sound knowledge of the principles underlying their engineering and geological aspects, not only starts with a pronounced advantage, but is enabled to assimilate practical details with far greater rapidity and certainty when once his mining career has commenced.

Suspicions Regarding Geology

The feeling amounting even to suspición with which geology is in some quarters regarded, is, perhaps, attributable to the following causes: First there are the nonsensical reports on mines and mining prospects —such as most of us can recall—made by charlatans who, by the use of an obscure geological phraseology, seek to impose their trite conclusions on the credulity of their employers; then there are the wearisome lucubrations of the irresponsible faddist who uses the columns of the local press to ventilate his absurd geological theories. However, geology is not the only science to suffer from the ignoramus and the bore.

A more serious disability perhaps lies in the employment in mining work of the academic geologist who has had no previous experience of mines and is unacquainted with mining conditions and economics. Imagine such a one—in his own province possibly a distinguished scientist—taken underground for the first time, groping his way in a murky atmosphere but dimly illumined by the miner's lamp or the glimmer of a candle, amid unfamiliar, and occasionally unpleasant, surroundings; imagine under such conditions his being asked to unravel the intricacies of a fault or to prognosticate the downward extension of an ore body.

In fact, the lavish natural indications, which at the surface attract the attention of the geologist, tend at first to elude him when he penetrates beneath it; since there the exposures are few in number, and, such as they are, small; moreover, they are, as a rule, covered with dust, begrimed with soot or buried in mud. Even to overcome initial difficulties, such as these, is not enough; to achieve a real success the work of the miner must be followed step by step, since in his progress he affaces the facts almost as soon as they are disclosed.

Separate Branch of the Profession

It must be abundantly clear that mining geology is a branch of the profession distinct from pure geology, and that proficiency in this specialized department cannot be attained without a proper training underground.

In the United States there is a growing tendency to differentiate the functions of the mining man; thus we find there an increasing use of the term "mining geologist" to designate a mining engineer strong on the geological side, or, what in practice amounts to the same thing, a geologist who has specialized in mining work.

On the other hand, the term "mining engineer" is occasionally used rather in the restricted sense of a mechanical engineer who has specialized in mining machinery. Thus, Profesor Munroe of the Columbia University, in contributing to the discussion of a paper said the mining engineer was called upon to design machinery for mining purposes and to superintend its construction and operation. He "should be able," he continued, "to test," among other things, the efficiency of boilers, steam and gas engines, air, hydraulic and other motors, pumps and compressors, electric lighting and power plants; telephone and telegraph systems, crushing, concentrating and amalgamating machinery and metallurgical plant, and to determine in each case whether the motive power, coal, gas, water, air, or electric current is economically used and the machines and mechanical devices are working to the best advantage. Or if this is not the case, he should be able to diagnose the trouble and indicate the remedy, and determine the conditions of maximum efficiency and economy."

Surely in writing this Professor Munroe must have had in mind the application of mechanical engineering to mining, neglecting for the moment its exploratory side, for it is clear that mining consists of two distinct parts: (1) The exploration and development of the ore body; and (2) the extraction and bringing to the surface of the ore, the first being essentially a problem in which geological principles are dominant, while in the second, mechanical engineering plays the chief part.

Proper Functions

Since the expression "mining geologist" appears to have taken a definite niche in the edifice of mining engineering, it may be well to attempt a definition of his proper functions.

In the province of metal mining, mining geology comprises the study of the ore deposit; its lithological environment, its enrichments and improvements and their cause, and finally the faults and dykes that traverse it and their effect. As a result of such investigations the mining geologist is enabled to trace the outcrop of the deposit; to trace and define the ore shoots; to predict, as definitely as the evidence will allow, their downward extension; to outline the scheme of development and method of mining best suited to their shape, size, dip and pitch and having regard to any existing dyke or fault disturbance; to determine the amount and value of ore immediately or prospectively available; and from the nature of its mineral association to suggest the necessity, or otherwise, of eliminating the gange by some form of ore dressing or concentrating machinery; and, finally, to give a preliminary opinion, based on the mineral composition, as to the docility or refractoriness, as the case may be, of the ore in regard to metallurgical treatment.

It is evident that the examination of a supposed mining field, or of a lode or ore body on which nothing but prospecting work has been done, is essentially the work of the mining geologist; and it may also be conceded that, provided he has served the requisite apprenticeship underground, understands the art of sampling, and can gauge with some approximation, to

* Presidential address before the Institution of Mining and Metallurgy, London.

accuracy the costs of mining and treatment, the inspection of a partially developed or "young" mine may also be properly entrusted to the mining geologist.

In the case of a fully developed mine, in which the whole, or practically the whole, of the available ore is blocked out for stoping, or at any rate is developed by drifts extending from end line to end line at the lowest levels permitted by the dip boundary of the property, the requirements are somewhat different.

Here what is wanted is not so much the drawing of inferences from the geological environment of the ore but a correct apraisement of the net profit obtainable by its extraction with due regard to the economic conditions prevailing. In this case, apart from the estimation of ore reserves, a consideration of the most suitable methods of extraction and treatment and questions of finance are of paramount importance. An actual apprenticeship in mine management, supplemented by a long experience of mine examination under the most varied conditions, are here the prime requisites for a successful valuation.

Similar differences exist in regard to the management of mining properties. Prospecting and exploratory mining are essentially the work of the mining geologist. Even in the normal development of a mine, questions often arise that cannot be solved without the aid of a sound knowledge of tectonic geology. It is true that on small mines the mine manager is often expected to possess the knowledge of the mining geologist, the mechanical engineer, and the man of business.

But big mines are, or should be, organized departmentally, and in that case are placed under the supreme control of a man chosen chiefly for his executive ability and power of organization, irrespective of other attainments. The machinery is, of course, controlled by a mechanical engineer, the reduction work by a metallurgist, the supply of ore by an underground superintendent or mine foreman; while the exploratory and development work is best superintended by the mining geologist. Surveying and sampling are natural adjuncts of the mining geologist's department, and indeed the mine surveyor is often himself a competent geologist, recording on his plans the faults and dykes disclosed in the course of development, and determining the quantitative effect of the disturbance and the loss or gain of ore thereby caused.

Role an Important One

It must be evident, I think, that the point I wish to make is that the role of geology in mining is more important than is generally conceded, and that a recognition of this involves either an extended geological training for the mining engineer or a relegation of a portion of his functions to the mining geologist who has been trained in underground work.

After all, whether a man is to be called a mining engineer or a mining geologist is of little moment; the important point is that the student who purposes to take up mining work as a profession should receive the best possible training for that end, and in this, I contend, geology must have a prominent place. The mining employer, for his part, should in all cases have a clear conception of what is essential for the proper development of his property, and should be able to choose a man whose special studies have fitted him for the particular work involved. If the mining employer requires guidance in this choice, that is the function of the consulting engineer.

Sampling Low-Grade Ore Deposit.

Before a meeting of the Mining & Metallurgical Socity, S. J. Jennings presented a novel way of overcoming the difficulty of sampling low-grade deposits a discrepancy between calculations and assays and why it is so hard to get a satisfactory sample of certain gold ores:

We have recently had an interesting problem in Alaska. The ore was supposed to carry $2 in gold, from which a profit of 75 cts. per ton was expected. An error of 25 cts. per ton in sampling might cut 33 1|3 per cent. from our profits. The question was, were we taking specimens or samples? We were cutting channels 6 in. wide by 2 to 3 in. deep, 5 ft. apart in the crosscuts; and while one might suppose that if there were enough crosscuts the law of averages would hold, and errors would balance themselves, we found that successive 5-ft. samples would assay from trace to $12 or even higher per ton; hence, it seemed unwise to depend on averages, when the total number of samples would necessarily be small.

We took samples over a strip 2½ ft. wide along the crosscuts for the full height, getting 30-ton samples for each 12-ft. crosscut. These we ran through a 5-stamp mill. At first 30-mesh screens were used, but finally a slotted screen equivalent to 60 mesh. The pulp from the stamp was run into a 12-in. launder and the stream was cut at periodic intervals, taking out 1¾ per cent. as a sample. This sample was amalgamated, and the tailings from the amalgamating barrel were sampled, which could be done with accuracy to within 4 cts. per ton.

Yet we were never satisfied that the gold recovered in the amalgamating barrel was the right proportion of that in the original ore. Suppose you took 32 samples of ¾ lb. each from the same ore, crushed to 40 mesh. If you crushed each sample to 100 mesh and split it, the halves would vary by, say, 4 cts. But if you took another of the original 32 samples, the variance between it and the first might be from $1.50 upwards, showing that even with 40-mesh material individual pieces of gold would go through the quartering process and not be proportionately distributed. Our millman finally put in a Wilfley table to concentrate the original 30 tons. We concentrated out about 1½ per cent of the original, which carried all the free gold, the pyrite, galena, etc. The tailings from this table could be sampled accurately. The concentrates were amalgamated in a barrel, the tailings from which could also be sampled. In order to ascertain the value of the original sample of 30 tons we had the following factors: Net dry weight of ore crushed; weight of concentrates recovered; total amount of gold recovered in the amalgamating barrel; assay of the tailings from the barrel; assay from the tailings from the Wilfley table; total amount of gold remaining in the sand around the dies in the battery. This plan has been working 3 to 4 months and we really have secured results that check.

Fine gold, according to Rose, may be drawn into wire of such thickness that 1 oz. will cover 50 miles. Gold leaf can be made one three-hundred thousandths of an inch in thickness.

Steam generated from waste heat of eight reverberatory furnaces at the Washoe plant, Montana, U. S. A., produces 30 per cent. of the 16,700 mechanical horse-power used in the entire concentrating and smelting plant. About 25 per cent. of the heating value of the total coal is made effective, while only 15 per cent. of this value is actually used for smelting.

Development of the Electrical Motor for Use in Mining.

Everett Drennen, in a paper read before the Kentucky Mining Institute, recently gave a historical summary of the stages of development which led to the introduction of the several types of electric motors now employed in mining and in metallurgical works. He said:

An electric motor is primarily a means of converting electric energy into energy of motion for the accomplishment of work.

The property of an electric current to produce rotating motion was accidentally discovered by Faraday as far back as 1821. He was experimenting with a magnetic field and accidentally suspended a loop of wire and noticed the effect of the field. He later deduced the properties of a magnet to rotate about a fixed current or about its own axis. About 10 years later he constructed a motor by using horseshoe magnets and two coils of wire, with string between the wires for insulation, wound on blocks of wood.

Thirty-five years later a philosopher by the name of Wilde replaced the fixed horseshoe magnets by electromagnets and a few years later the one coil was replaced with a series of coils by the man Gramme, to whose credit the electric dynamo is placed.

This principle of a dynamo upon which Gramme's invention was based is that magnetic influence exerted in certain lines radiating from the poles of the magnet may be cut and the energy collected by passing a closed loop of wire through them. The current or electromotive force set up in this wire depends on the rapidity of revolution or passing the field, the strength of the magnet, and the angle at which the wire passes through the field. The current set up by such action does not flow in one direction, but consists of a series of reversals in opposite directions.

Alternating Current and Direct Current

Up to this point alternating-current and direct-current machines in the present-day construction are similar. In one, however, the current is transmitted through conductors and used as it is generated in the machine, that is to say, in a series of starts and stops or complete reversals, such being called the alternating current. In the other by introducing into the dynamo a device called the commutator, the current produced in the armature is, so to say, straightened out or flows in one direction and there is then obtained what is called the continuous current.

Today, electric motors, or reversed dynamos of essentially the same construction as Gramme's machine, are operated on alternating-current and direct-current circuits as the convenience and economy of operation may suggest. It might be well to discuss briefly various types of commercial motors in practical service in connection with mining operations before dealing with the direct application to these various operations.

Alternating-current motors for single-phase, two-phase, and three-phase circuits are used for mining operations on practically all standard voltages, from 110 to 6,600. The standard commercial voltages for alternating-current, three-phase, direct-motor operation are 110, 220, 440, 550, 1,100, 2,200 and 6,600, corresponding to the standard transmission voltages for delta connected equipment. While motors may be operated on the same circuits connected in Y, the voltage figures in this case should be multipled by the square root of 3 or 1.732.

Three-phase transmission at the above voltages has become the recognized standard and it is hardly consistent with a practical handling of this subject to speak of the single-phase two-wire, two-phase four-wire, two-phase three-wire, or three-phase four-wire transmissions. The motors that operate on these circuits differ from the three-phase motors only in the method used in winding them. While it is possible to use any of the above systems for mining operations, the three-phase three-wire and the single-phase two-wire for series wound motors are the only practical ones in operation. The six-phase motor is sometimes used, but is hardly practicable.

High Voltage Transmission

The purpose of high voltage transmission of alternating current is based entirely upon economical construction and operation, and should conform where practical to 1,000 volts per mile of transmission. While motors are rarely operated on voltages higher than 6,600 transmission lines are constructed for voltages up to 110,000. The nicety of commercial electrical practice is demonstrated in the fact that the voltages for the standard delta connected equipment are all multiples of the lowest commercial voltage in use.

Alternating-current motors are divided into two classes, synchronous and non-synchronous motors, the latter class of which is subdivided into induction motors of the squirrel-cage and wound-rotor type, and the single-phase series motor.

Synchronous motors operate in parallel with the generating unit in precisely the same manner as a second generator would be made to operate in parallel with this generator; it is practically a reversed generator. This type of motor requires separate direct-current field excitation, which is often an inconvenient feature in connection with their operation under ground. It is generally built with revolving heads composed of laminated steel cores wound with insulated wire for the direct-current excitation.

The non-synchronous induction motor is manufactured in two types, the squirrel-cage and wound-rotor types. The so-called squirrel cage is practically the same as a self-starting synchronous motor, excepting that it does not have field coils wound for direct-current excitation. The fields on this type of motor have only the squirrel-cage winding. As the general name "induction" infers, this type of motor requires no sliding contacts. It is especially adaptable wherever constant speed is required. It has three to four times full load torque at starting. Its construction is extremely rigid and the motor is less affected by dirt than any other known type.

Other Types

The wound rotor induction motor differs from the squirrel-cage type in the rotating element only. In place of the squirrel-cage winding, which is simply a winding consisting of straight copper bars all connected at both ends by a copper ring, wire-wound coils are used in the rotating element, and these are connected to collector rings on the shaft of the motor. Carbon brushes collect current from these rings and in turn connect through a controller to resistance.

The alternating-current, series wound, single-phase motor is practically the same as the direct-current, series-wound motor, excepting that resistance is usually placed between adjacent commutador segments to reduce the inducted current in the coils which are short-circuited by the brushes. This motor can be operated on a direct-current circuit very well, but a direct-current, series-wound rotor is not so suitable for service on an alternating-current, single-phase circuit, due to the above construction.

Direct-current motors are operated in connection with mining very extensively. The practical range of voltage for this class of work is from 110 to 500, while the most common voltage in use underground today

is 220 or 250. All direct-current motors are commutating motors and the difficulties incumbent with this feature limit the voltage as above stated. Direct-current transmission which is more economical at the same voltage than any from of alternating-current transmission, should be limited where practicable to 1 mile for 250 volts and 4 miles for 500 volts.

Series-Wound Motors

A series-wound motor consists of a revolving armature built of form-wound, or hand-wound, coils placed in slots in a laminated steel core. This steel core is either keyed direct to the shaft or held by a cast-iron spider which is in turn keyed to the shaft. The ends of the copper coils in the armature winding are brought out to one end or neck of the commutador bars and soldered.

This makes two or more continuous circuits from any point on the commutator to any other point on it. The field consists of form-wound copper coils placed over laminated, or cast-steel, pole pieces. Two, four, or six pole motors are used in mine service and these poles are placed equally about the armature. As the name implies, the fields are connected in series with the armature for the purpose of producing excitation that will vary in proportion to the load. Thus, the series-wound motor is adaptable to variable speed loads where a high starting torque is required and the load is never less than a fixed amount.

The shunt-wound motor has the same general construction as the direct-current series-wound motor, excepting that the fields are wound with finer wire and armature. The shunt-wound motor is practically a constant-speed motor with a constant torque. It is adaptable to uniform loads where excessive starting torque is not required.

The compound-wound motor is a combination of the series and shunt-wound motor, having the same armature construction and shunt field coils with small series fields superimposed. For a motor of given horsepower at a certain speed a compound-wound motor would be designed for the same full load speed as a shunt wound motor. Thus, on light loads with a corresponding loss of effective field strength by reason of the series field carrying current only in proportion to the load, the speed of the compound-wound motor would be greater than that of the corresponding shunt-wound motor. This feature works out to advantage in that starting under heavy load the field strength of a compound motor is increased, thereby increasing the torque at starting. This motor is adaptable for operating under fluctuating loads because the torque varies, as mentioned, in proportion to the load.

All direct-current motors can be built with auxiliary poles called "interpoles," which assist the weakest point in connection with the operation of direct-current motors, viz., the commutating feature. An interpole is a series coil placed on a small pole piece midway between each two adjacent main poles or fields. Interpoles are placed between each two main fields. The object of these interpoles is to set up a flux that is equal to and in opposition to the flux set up by the armature. This prevents the shifting of neutral points on the commutador, thereby providing for sparkless commutation at all loads in either direction of rotation.

Mine Haulage

For locomotive haulage it is necessary to provide either a storage for power or a transmission circuit of sufficient capacity to provide for peak loads on the motor at any point of the service. In mine haulage there is always a fixed minimum load on the motor which condition makes it possible to use a series-wound motor, either alternating or direct current. Heavy starting torque at low speed is also desirable and is one of the features of a series-wound motor.

The voltage loss in single-phase alternating-current transmission is such a consideration that this motor is not deemed practicable for mine haulage. The simple single-phase connections is not capable of producing a heavy starting torque. which is another disadvantage for this service. The direct-current straight series-wound motor is, therefore, the practical motor for this equipment. The interpole feature would not add to the adaptability of this motor, because of the small horsepower and slow speed found in most of the locomotive equipment.

For continuous chain, or rope, car haul, the shunt-wound interpole direct-current motor is satisfactory, while if located outside the mine an induction motor makes a very satisfactory drive if an alternating-current circuit is available.

Hoists

For hoisting, a large starting torque and good speed regulation are two requirements for the motor. For large underground hoisting installations the wound-rotor type of alternating-current induction motor with variable speed is giving excellent service, power being carried to the motor at high voltage over the surface to a bore hole at the site of the hoist and down the bore hole in lead-encased cable. This method of connecting and operating a large hoisting installation is particularly advantageous if the installation is some distance from the power house.

For the small portable hoists the direct-current series-wound motor with suitable control, or the squirrel-cage induction type alternating-current motor, is best adapted. Constant speed is not required for this class of work and the motor best suited to starting under heavy torque is well adapted to this class of work.

Motors for Pumps

It is considered good practice today to so ditch the underground workings that water may be drained to as few pumping sumps as possible. This generally necessitates a large pump located at a considerable distance from the source of power. For such an installation an overland, three-phase alternating-current circuit at high tension, taken down the bore hole through lead-encased cable to the pump motor, is considered the most desirable means of providing power. In this case the squirrel-cage type of induction motor would be most suitable for the operation.

Because of the initial cost of both pump and motor and the proven satisfactory service given, high-speed centrifugal pumps are gaining in favor throughout the country for this service. The large reciprocating pump underground means an enormous chamber which usually must be arched and supported with steel. It also means transporting the pump to its location piece by piece, and making the best fit possible with the pieces after they have reached their destination. It also means slow operating speed with a comparatively slow-speed motor connected through a train of gears to the pump crank-shaft. The innumerable repair parts in the large reciprocating pump and the comparatively great surface exposed to the action of mine water, are facts tending to condemm this type.

If alternating current is not available, the shunt or compound-wound direct-current motors are suitable for this service. In this event if the pump be located more than a mile from the source of power, the mine voltage being 250, it would be advantageous to install a separate generating unit for pump-motor drive and

carry the transmission lines overland to a bore hole, whether the circuit be 500 volts direct-current or a higher voltage alternating current.

Detection of Platinum Metals in Cupellation Beads.

G. H. Stanley, in the Journal of the Chemical, Metallurgical and Mining Society of South Africa, gives simple directions for detecting the presence of platinum, palladium, iridium, etc., in cupel beads without going through the tedious process of analysis. Some assayers claim to be able to detect by the appearance of the beads as small a proportion of platinum as 2 per cent. the beads having a peculiar crystalline lustre. The author has developed this simple inspection method, by controlling the conditions and by placing the bead under a low-power microscope.

It has long been known that platinum metals in cupellation beads give certain indications of their presence, but very little definite information is obtainable on this subject, and many conflicting statements have been published as to the nature of the indications to be attributed to the various metals.

In the case of platinum for example, a surface crystallisation is visible to the naked eye when a certain amount is present, 2.2 per cent, according to Van Riemsdijk's statement made in 1879, but 1.6 per cent. according to our more recent observations. With more than 1.6 per cent. platinum this crystallisation gives the beads a frosted appearance. Many assayers, experienced in the assay of platiniferous materials, however, claim to be able to detect with the naked aye the presence of smaller quantities than are required to cause distinct crystallisation. According to such observers the beads show a peculiar steely-grey iridiscence. This possibility of detection has, however, proved to be very uncertain, for, on submitting a number of beads of known platinum content to experienced assayers, the predictions have proved most disappointing. The indications given by the presence of other metals of the platinum group have proved to be equally disappointing as a means of detection.

In view of the fact that the price of platinum has rapidly and continuously increased since 1894 (from 42s. to 180s. per oz.), and the demand for platinum metals has grown enormously, it is desirable that these metals should be easily detected, especially during the assay for gold and silver. Unless some definite indications of the presence of small quantities of these metals are given to the assayer, he is liable to overlook their presence, especially in the case of platinum and palladium.

Method of Detection

The method of detection described in this paper enables the assayer easily and quickly to foretell the presence of these valuable metals, even when present in such quantities as do not give indications to the naked eye.

The method adopted by the authors consists of an examination of the surface of cupellation beads by a low-power microscope fitted with a ¾ in. or 1 in .objective. No preliminary polishing, etching or other preparation of the surface is made, the beads being taken direct from the cupels and mounted on microscope slides by means of plasticine. Either oblique or vertical illumination may be used, although the authors prefer vertical illumination.

It is obvious that for microscopic examination, large beads are more suitable than small beads. It has been found possible, however, to detect 1.0 per cent. platinum in silver beads weighing 0.05 grm. and as little as 0.4 per cent. in beads weighing 0.1 grm. In the examination of materials containing an excess of platinum metals over the gold and silver contents, such as some of the "black sands," the authors have found it advisable to add a quantity of silver sufficient to give a good cupellation bead. It is a better practice to ascertain the amount of silver necessary by preliminary experiment and then to add this amount to the subsequent charges during fusion. On the other hand, in the examination of materials containing very small amouns of platinum metals, but more than sufficient gold and silver to enable the bead to be examined, it is often a great advantage to part the bead in sulphuric acid and to cupel the residue with a small amount of silver.

When it is desired to ascertain the presence of platinum metals in material giving minute beads by the ordinary assay methods the best mode of procedure is to collect the parting solutions and residues from a batch of assays and to treat as follows. The silver solution is evaporated carefully in a porcelain basin until quite dry, the residue is then washed into a lead basin and again evaporated to dryness. The lead dish is then scorified and the resulting button cupelled. The bead thus obtained may be examined by the microscope for platinum and palladium. An indication of the presence of palladium will be given by the colour of the parting acid. The gold residues are weighed and cupelled with four times their weight of silver, the resulting bead bing afterwards examined.

Appearance of Beads

The authors do not suggest that these methods should replace the ordinary assay methods, but rather that they should be used as a means of detecting the presence of platinum metals. When beads prepared by cupelling pure silver are examined under the microscope, a great variation in structure is observed. In some cases crystallization is found to proceed from definite centres whilst in other instances distinct crystal grains are to be observed, the result of the growth of crystallites which have grown until interfered with by the encroachment of similar crystallite growths.

With beads obtained by the cupellation of gold with silver the structure is found to vary according to the relative proportions of the two metals. Beads of high gold content approach in appearance that of pure gold and vice versa.

In describing the effects of platinum on the surface structure of silver beads it is admitted that amounts less than 0.3 per cent. give insufficient indication of their presence. With more than 0.3 per cent., however, there is a tendency for the boundaries of the chyrstal grains to become distorted and the surface to take on a corrugated appearance. With increasing amounts of platinum these corrugations increase in number until the whole surface of the bead is covered by them.

The effect of platinum on gold beads, although similar, is not so distinct as on silver beads. With the same amount of platinum present corrugations are not so numerous on taking into consideration the whole surface of the bead. It is possible with the lower percentages of platinum, for example 0.5, to find portions of the bead showing no corrugations whatever. The effect of platinum on beads containing gold and silver is similar to that already described. The structure moreover is more marked than in the case of beads consisting of gold only.

With palladium, the surface appearance of the beads is very similar to that produced by platinum. Unlike platinum, which gives a frosted appearance when more than 1.6 per cent. is present, palladium may be present to an extent of 2 per cent. without giving definite indications to the naked eye. Immediately on proceeding to the parting operation, a difference is obtained in the colour of the parting solution. Whether sulphuric

acid or nitric acid be used, it will become faintly yellow if palladium is present, deepening in tint as the palladium increases in quantity and as the parting proceeds.

Turning now to the effect of iridium on silver beads, it is found that these are always enlarged as compared with silver or silver-platinum beads of the same weight. The shape assumed by these beads is much more spherical both on the upper and lower surfaces giving to them the appearance of having been blown out. Under the microscope the boundaries of the crystals are clearly seen, but the facets are striated in more than one general direction. This appearance suggests that the beads have been subjected to severe internal stresses, and the result may be compared to the faults produced by nature in rocks. In some cases, however, the beads spit, more often from the bottom than from the top, thus tending to relieve the stresses producing the characteristic markings which, however, are not entirely eliminated. On making a cross section through silver-iridium beads which had not spat, a cavity was found in every case, thus supporting the contention that the enlargement was due to some internal force. This force is evidently produced by the liberation of oxygen from the solidifying silver, there being a sufficient thickness of solid crust to prevent its escape with the production of the ordinary spit.

Rhodium is found to have quite a different effect on cupellation beads than either of the other platinum metals.

When more than 0.3 per cent. rhodium is present the surface of the beads has a bluishgrey colour which becomes deeper as the amount is increased until the beads become blue-black. With less than the amount of rhodium stated a very beautiful crystallisation visible to the naked eye is produced. This is found to apply equally to beads of gold and gold-silver.

This extremely coarse crystallisation is probably due to the fact that rhodium prevents the undercooling of the beads, thus reducing the number of centres produced in crystallisation. Another striking phenomenon is the persistent spitting of silver beads when 0.03 per cent. and upwards of rhodium is present. All attempts to prevent this tendency proved futile, and the silver ejected from dark-coloured beads had the characteristic silvery-white colour of pure silver.

On repeated cupellation, the rhodium is gradually removed, and it is possible by this means to get rid of so much rhodium from dark colored beads, that the crystalline surface above noted becomes visible.

In the case of small quantities of ruthenium a black crystalline deposit is always found on the bead. In the majority of cases this deposit is situated ot the edge of the bead near the bottom. Unlike the surface film due to rhodium this deposit is distinctly crystaline, and is not so readly eliminated by repeated cupellation.

Notes on Air Lifts.

The operation of the lift depends on the buoyancy of aerated liquids. To obtain the desired results, air is pumped through a small pipe to a convenient point below the surface of the liquid, where it is allowed to discharge into a larger pipe through which the aerated fluid rises. It is important that air be admitted to the fluid in a finely divided state and in such a manner as to realize the full cross-sectional area of the discharge pipe for the passage of the liquid.

The successful operation of the air lift for pumping depends upon a number of factors, most important of which are: (1) The height of the column of fluid that the aerated mixture has to overcome or the height from air inlet to the surface of liquid in the well. This is known as submergence. (2) The total vertical distance from the point of admission of air to the point of discharge, the ratio between these two quantities representing the percentage of submergence. (3) The lift or distance from the surface of the liquid to the level of discharge. (4) The air pressure.

Several formulas have been derived in an effort to develop a theory of the air lift pump on a mathematical analysis of the problem. Davis and Weidner state that "by varying the percentage of submergence, and therefore the lift, the length of pump remaining constant, the maximum efficiency (pumping water) is obtained at approximately 63 per cent. submergence for all rates of input or discharge."

Quantity of Air

The consumption of air varies with change of any of the conditions affecting the efficiency, such as submergence, height of lift, etc. Representative tests have shown a consumption of 11 or 12 volumes of free air to one of fluid pumped, and for less efficient operation the proportion of air to fluid may be 15 to one, or more.

The quantity of air should be carefully regulated, the best results being obtained with the minimum volume of air necessary to cause the liquid to flow in a constant stream. Owing to the extra pressure needed to overcome the friction and inertia, the starting pressure is about double the working and calculated air pressure.

The Estimation of Mercury (Cumming and Macleod, Jl. Chem. Soc., 103, 513).—Penfield's well known method for determining water, especially in minerals, has been adapted for the determination of mercury in ores and minerals. In a piece of glass tubing 20 cm. long and 5 mm. wide, two bulbs are blown, one at the closed end and another near the open end. A small quantity of the powdered sample mixed with lime is filled into the clean, dry tube through a drawn-out glass funnel. The tube is then filled up to a depth of 8 cm. with iron filings and quicklime. An asbestos plug is pushed in midway between the bulbs, and the open end of the tube drawn out to a fine capillary. The end bulb, with its charge, is heated at first inside an iron pipe, finally in the flame itself, the mercury being driven out and condensed in the second bulb, which is kept coolled. This bulb, with the mercury, is the drawn off, the moisture present is removed by a current of dry air, and the bulb and its contents weighed. The mercury is then run out and completely removed by drawing a current of air through the hot tube. Finally the empty tube is weighed. If sulphides are present lead chromate should be added to the mixture before heating.

Matte from cyanide clean-up is easier to treat when it contains more gold than silver. If it rich in gold, with some silver, the gold will be reduced at once and the silver remains in the matte, especially when treating it with iron shaving, according to G. Simpson, of the Ketahoen mine, Sumatra. For every 100 oz. of silver in a silver matte he collects, 2.2 of turnings is added in melting. Cast iron is not as good as steel for this purpose. The matte is run down first with 1.1 lb. of iron, then a second time with a similar quantitiy, it being found better to do this than to melt hot at once. After refining gold and silver bullion in a crucible, it is found that matte sticks hard to it when poured into a mold. The higher the value of the matte, the tighter it adheres to the bullion. If a little cyanide salt is added during melting, this makes the matte of lower value, and it separates easily from the bullion. The addition of a little iron shaving during melting acts in a similar way, is cheaper, and there is no danger from fume.

The Old Oaken Bucket in Mexico. Courtesy Mexico View Co.

Drying Coffee. Courtesy Mexico View Co.

Hitting the Grit. Courtesy Mexico View Co.

The Ship of the Mountains. Courtesy Mexico View Co.

PERSONALS.

George Bridger, of the Real del Monte Co., has returned to the property from the States.

L. K. Fletcher and George Noble have gone to Durango on mining business.

Wm. Benham has returned from Central America.

Arthur Fuest, superintendent of the Cedro mine in Nicaragua and well known in Mexico, where he formerly was located, has returned to Nicaragua from the States.

Morris B. Evans is in charge of the construction of the new cyanide plant of the Javali & Escandalo Mining Co., Nicaragua.

J. P. Lake succeeds Geo. Fairburn as manager of the Babilonia Gold Mines, Ltd., Nicaragua.

Cecil Pocock, who has been connected with mining enterprises in Central and South America for a number of years past, has returned to thhe United States and is now at Bayonne, N. J.

Jeffries J. White is in Durango.

George Henderson, formerly of Pachuca, is with the Lluvia del Oro company in western Chihuahua.

H. W. Fowler has returned to Mexico City from Temascaltepec, Mex.

C. N. Van Law, manager of the Cia. Minera Real del Monte y Pachuca, has returned to Mexico from the States.

M. C. Scheble is at Bokoshe, Okla.

Walter S. Larsh is with the Chile Exploration Co., Chuquicamata, Chile.

Wm. T. Cardwell, formerly of Cananea, is now with the Yoquivo Development Co., Minaca, Chih.

Percy Stockdale, of Cinco Minas has been visiting friends and relatives in Mexico City.

R. McCormick has returned to Guanajuato.

R. B. Brinsmade, of Puebla, delivered a lecture on the taxation of mining and agricultural lands before a meeting at the Y. M. C. A. in Mexico City on Nov. 28

H. M. McQuatters, of Parral, was a passenger on the first Central train to arrive in Mexico from the north last month.

C. C. Archibald, assistant superintendent of the Cinco Minas mill, has been in Mexico City looking up supplies of dynamite and cyanide for the company.

Bernard MacDonald is at Tombstone Ariz, conducting experimental work in cyaniding on the ores of the mines recently purchased by Phelps, Dodge & Co.

L. D. Ricketts will on Jan. 1 resume the management of the Cananea Copper Co., when operations on the property will also be resumed.

Walter F. Stevens, formerly manager of the Ferrobamba copper property in Peru is in London.

George Kingdon, who has been in charge of mining for the Greene-Consolidated Copper Co., has been made general superintendent of the company operations.

Philip C. Snodgrass, well known in mining circles throughout Mexico, has returned to the republic after several months' visit in the United States.

C. W. Partridge, of the A. S. & R. Co., has returned to his post in Aguas Calientes.

Karl E. Lloyd, formerly of Mexico and recently with the Central Chile Copper Co., has returned to the United States.

W. C. Buchanan is at the Santa Gertrudis, Pachuca.

W. E. Crawford is cyanide mill superintendent at Santa Gertrudis, Pachuca.

G. R. De Beque has returned to Guanajuato to resume charge of operations of H. H. Miller & Co. at the San Carlos mine in Santa Rosa district.

H. J. Baron, manager of the Mexican Chemical Co., Chihuahua, has returned from a business trip to the States.

H. T. Stretton, of La Blanca mine, Pachuca, Hgo., is in London.

H. E. West, formerly of El Oro, is at Santa Barbara, Calif.

J. B. Perry, S. B. Elbert, J. E. Gelder and L. W. Trankle, all of whom were formerly interested in Mexican mining, are now at Yerington, Nevada.

F. D. Chase is at Monterrey, N. L.

R. G. Dufourcq is with the Moctezuma Lead Co., Santa Barbara, Chih.

J. Gordon Hardy has returned to El Paso, Texas.

Ernest Harms, manager of the Torreon smelter, is at Torreon.

L. W. Kemp is at Chuquicamata, via Antofagasta, Chile.

Blamey Stevens is at the Lane-Rincon mines, Temascaltepec, Méx.

R. B. Kepner is at Velardeña, Dgo.

F. W. Oldfield is now with the Mexican Mines Co., Bolaños, Jal.

Otto Tuschka is connected with the Monterrey smelter.

Albion S. Howe is with the Minas de Matahambra, Prov. Pinar del Río, Cuba.

Chas. P. Bone is with the Chas. Butters Co. at Valparaiso, Chile.

Nelson Dickerman is general manager of the Pato Mines, Ltd., Barranquillo, Colombia.

Ralph Dougal, formerly at Aguascalientes and Mapimí, is chief engineer for the Bankhead Mines, Bankhead, Alta, Canada.

Geo. A. Easley is manager of the Olla de Ore Gold Mines Ltd., La Paz, Bolivia.

Guy M. Kerr, formerly at San Juan de Guadalupe, is with the Garfield Smelting Co., Garfield, Utah.

H. H. Lauer, formerly of Guanajuato, is engineer of the Midvale Steel Co., Philadelphia, Pa.

Frank J. Booth is at Sultepec, Méx.

Geo. B. Dillingham is with the Cia. Minera de San Vicente, San Vicente, Sinaloa.

Fred A. Roberts has arrived in Mexico to superintend the engineering work of the Corrigan-McKinney Co. on its copper mines in Chihuahua.

R. N. Copeland, mine superintendent of the Cia. Estanifera de Llallagua, Bolivia, is visiting in the States.

Fred Alvord, superintendent of the Sonora Copper Ore Co., has returned to Noria, Son.

O. B. Glover is to resume operations at the Patsey mine in the Magdalena district, Son.

Mark Wanless, ore buyer at Hermosillo, Son., will open an office in Nogales.

A. L. Lewis, of Lewis & Hart, has returned to Hermosillo from a business visit to the States.

A. D. Richmond, of the American Mines Co., has returned to the company's property at Minas Prietas, Son.

Jas. M. Campell is preparing to extend a shaft of the Mexico Mines of El Oro another 1,000 ft.

A. C. Cole, smelter superintendent of the Cananea Copper Co., has returned from a business trip to the States.

END OF THE TRAIL.

William C. Beckmann, pioneer mining man of Parral, Chih., died in El Paso of heart failure at the age of sixty-six years. Mr. Beckmann was heavily interested in mines and ranches in the state of Chihuahua and was reputed to be one of the richest men in Mexico.

Otto Koehler was shot and killed in San Antonio, Texas, Nov. 12. He was largely interested in mines in the state of Durango, Mexico.

PATIO

The Hall process of roasting for the direct production of the element, sulphur, consists in reducing the oxidizing action to a point in which enough hydrogen sulphide is driven into the flue gases to balance the sulphur dioxide, a reaction in the flues releasing the sulphur in both compounds to the elementary form. Whether the reaction is due primarily to the hydrogen sulphide or to gases derived from the burning fuel has not been determined.

The presence of lead either in the solution or in the zinc dust or shavings is generally regarded as desirable for precipitating gold, especially from very weak solutions. As zinc dust usually contains from two to three per cent. lead and zinc shavings rarely less than one per cent., the zinc-lead couple is practically always in force in the precipitation room.

Experts do not as yet agree as to the functions of lead salts in cyaniding ores. It has been claimed that lead in solution removes the soluble sulphides, but it has been shown that solutions rarely carry these sulphides and if they do that the sulphides rapidly disappear, the zinc derived from the zinc boxes being quite as effective in precipitating this compound. The prevailing opinion seems to be that it saves cyanide by preventing the formation of sulphocyanates, and also aids in the solution of silver sulphides. It is helpful when the solutions carry a small amount of copper, but not when the proportion passes a certain point. It is said that almost any lead compound is equally effective, even ground galena being applicable. The salt selected must depened upon cost. The use of too much lead is often as harmful as to employ none at all, skill being always necessary in its use. Lead salts, while they may not be necessary in the mill when under working conditions, is often required during starting up, fresh solutions being apparently devoid of the compounds which in used solutions perform the same service.

A single blast on the shores of San Francisco bay recently broke 166,250 eight holes and each pound of powder tons of rock in a suitable condition for removal by steam shovels. There were broke 9.5 tons of rock.

Cement or concrete lined iron pipes have lately come into use. The mortar is forced through the pipe in lengths by means of a piston, and the lining smoothed up before setting by means of mandrils.

A new Belgian explosive, named sabulite, has recently been subjected to exhaustive trials in Butte, Mont. It is composed of a mechanical mixture of calcium silicide, ammonium nitrate and a nitrotoluene to give volume of gases. It does not give off poisonous gases and is remarkably resistant to accidents in handling. It cannot be exploded by heat. A piece placed upon a fire melts and burns slowly, and a cartridge was broken to pieces with a red-hot bar of iron without explosion. Even a high-velocity rifle ball was shot into a cartridge merely cutting it in two. A piece placed upon a block of granite and drilled through with an ordinary drill is said to have caused no explosion.

The capacity of a thickener does not depend entirely upon area of settling surface. Even with pulps crushed to the same size there is a wide variation. Something depends upon the shape of the grains, but more upon the electrochemical relation of the particles to the solution, which affects the viscosity or cohesion of the particles. A ton of kaolin or hidrated oxide iron slime may require many times the area required for straight quartz slime.

A number of attempts have been made to produce zinc from its ores by electrolysis of a fused medium in which the zinc compound would dissolve, similar to the tmehod used in the preparation of aluminum. In a recent investigation of this subject the process failed because the zinc either separated in globules and failed to separate from the electrolyte or the zinc burned at the cathode due to the higher temperature produced there.

A water- cooled flat roof for reverberatory furnaces is the subject of a recent patent. Ordinary buckstaves support a series of water jackets. From these are suspended either by bolts or dovtail grooves the firebrick forming the lower surface of the roof.

The Bell mill in the Gwelo district. Rhodesia, exhibits a number of unusual features. The ore is dried and crushed in ball mills, after which it is roasted in Edwards roasters, then brought into contact with cyanide solution and further ground in tube mills. After agitation the pulp is filtered in Dehne presses, and the solution clarified and precipitated in zinc boxes as usual.

In the custom mills which cyanide the sulphide ores of Clear Creek and Gilpin counties, Colo., it has been found impossible to treat all ores according to one flow-sheet. A double flow-sheet is, therfore, employed, one for the coarse grained material which yields its values to comparatively coarse crushing and the other for ores which require fine grinding. The battery bin is divided and the stamps are equipped with coarse or fine screens as the character of the material may require.

A gold dredging company in the western U. S. has equipped two dredges with jigs to save the values in its black sands and to make a better saving of gold. Ordinary plunger jigs were at first used on this floating concentrating mill, but later a new type was devised and installed. The new jig has both compartments rigged with screens, the pulsation being produced by means of a broad paddle between, the paddles actuated by an arm connected with an eccentric. These vertical paddle jigs are said to save much room and also eliminate many power transmission difficulties.

Much of the efficiency of drilling, whether machine or hand work, depends upon the quantity and character of the steel supplied the miners. Slipshod methods can not give satisfactory results. If the men are left to rustle their own steel, the first comers will get the pick of the starters while later comers will carry to the face only long steel. Racks supplied with sharpened steel save much confusion, the racks giving a distribution where required. In this manner all the men get the exact implements required and it is easy to keep track of the dull steel which needs redressing.

If elevator belts slip and slide off the head pulley, it indicates that the head pulley shaft is not level and in line with the boot pulley shaft or that the belt is too loose. If a poor grade of belting is used in elevators, there will be a continuous stretch and always danger that some of the plies will stretch more than others with a consequent cracking of the stiffer plies and a weakening or destruction of the whole belt.

The new radio-chemistry has overturned many of basic conceptions of the older chemistry. It is now generally believed that elements are by radio-activity changed into others. Thus, lead is in some cases formed from uranium. More surprising still it has recently been proved that the atomic weight of lead varies according to the way in which it has been formed. Two specimens of lead recently tested at Harvard University proved to be identical in every respect, even before the spectroscope, but they differed in atomic weight and radio-activity. The difference in weight was, however, not sufficient to interfere with the standard calculations of analyses and slags.

Flores Mill at Guanajuato.

CONCENTRATES.

Aguascalientes

A. S. & R. Co.—The members of the operating force at the smelter were ordered back to duty and the works are now running to half capacity. Operations will be increased as the mines and shippers which furnish the raw materials get back to regular work.

Torreón

Torreon Smelter.— At a meeting of the stockholders and directors of the Cia. Metalúrgica de Torreón held in San Antonio, Texas, last month, a dividend of 4 per cent was declared and steps taken to increase operations at the plant to full capacity. The dividend declared was 160,000 pesos, the remainder of the 8 per cent dividend due from the profits of the year ending June 30, 1912, about the time the smelter was closed down owing to unsettled conditions in that section. About two months ago the Torreon plant opened to dispose of the silver, lead and copper on hand. The capacity of the plant is about 1,000 tons per day. It has ten furnaces and employs about 800 men. Manager E. Harms reported the plant to be operating at about one-third capacity, the chief difficulty at the moment being the want of laborers and lack of communications with the various mines that furnish ore for the smelter. The plant was not molested during the year and a half of idleness and no repairs were necessary when operations were resumed in September.

Chihuahua

Mining conditions are good throughout the state of Chihuahua. The Chihuahua smelter is running regularly on ore from the Santa Eulalia, Cusihuiriachic and other districts. The large mining companies in the above named camps are working as usual. Many of the mines in western Chihuahua have resumed operations, among them the Lluvia de Oro, Batopilas, Yepachic, and others. In general the mining industry of the state is in a favorable condition and is increasing in importance daily.

Mexico

El Oro District—All the mills are working except the Dos Estrellas which is being overhauled for starting up at full capacity. The scarcity of dynamite is hindering work generally, but this is expected to be relieved by about the beginning of the year.

Hidalgo

Pachuca—Mining operations are going steadily ahead at all the large mining enterprises in the Pachuca and Real del Monte districts. The threatened suspension due to shortage of cyanide and dynamite has been met by a large supply from the United States which has been shipped and will be on hand in ample time to forestall a shut down.

Guanajuato

The mines and mills in the Guanajuato district are working steadily with good results. There is nothing new to report except an increased resumption of activity in the district. All of the large companies are working.

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ASK FOR CATALOGUE.

Oaxaca

A considerable amount of mining is being done in the state, particularly at Taviche, Sierra Juárez and the other large camps. The industry has been considerably hampered by lack of railroad communication in the past but it is anticipated that with restored railway service there will be unusual activity during the coming year.

Durango

A great deal of mining is being done in the state of Durango. Many of the companies have continued active operations during all the revolutionary period while others have resumed work during the past few months. The smelter at Asarco is in operation and the mines contributory to it are furnishing plenty of ore to keep it going. Work has been resumed at Guanacevi and Inde and in the San Dimas district, on the line between Durango and Sinaloa, there are four important properties that have worked steadily ahead throughout the troubles of the past few years: the San Vicente, San Luis, Mexican Candelaria and Estaca.

San Luis Mining Co.—Important additions to the mill were made during the troublous times, the tonnage now crushed being 120 tons daily. During the past three or four months the mill has averaged 100 bars of bullion per month. About one-half the value is in gold.

Mexican Candelaria—Both mine and mill are running at full capacity, 100 tons of ore being milled per day. A new tramway has been installed and plans are being made to add another which will enable the company to treat the old Candelaria dump.

San Vicente— This property, just across the Durango line in Sinaloa, is daily crushing about 35 tons of 30 oz. ore. An additional tube mill and other improvements are planned.

Estaca—This company, which has taken over the old Contra Estaca and other smaller properties, is doing extensive prospecting and is planning to erect a 100-ton mill.

Sonora

The Cananea works are to resume operations Jan. 1.

The mines and mills in the Moctezuma, Nacozari and El Tigre districts are operating normally.

El Tigre—Although railroad traffic was cut off for a time at last reports this property is producing steadily. Scarcity of supplies and the drop in silver have not prevented the continuation of work on a large scale.

Nacozari Consolidated Copper Co.—According to official reports of the company the installation of the new mill equipment is to be pushed in order to begin treatment of the large tonnage of ore developed. An ample supply of fuel is on hand and everything is in readiness to receive the remainder of the machinery.

Lampazos Silver Mines Co.—This company, composed of mining men of Bisbee, Ariz., is to resume operations under the management of Frank Borgenson. The operations have been suspended for some time, owing to the slump in the metal market and also to unsettled conditions in that part of Sonora.

Zacatecas

El Bote—This property has been working for some time practically to normal capacity.

Zaragoza—Work is going ahead on this property.

Magistral—This property is working regularly.

Most of the mines throughout the state are now in operation and after the first of the year it is expected that most of the mines will be in steady operation.

New Publications.

Mechanism of Steam Engines, by Walter H. James, S. B. and Myron W. Dole, S. B. of Massachussetts Institute of Technology, 8vo, 170 pages, 183 figures; cloth, $2.00 net; John Wiley & Sons, Inc., New York.

Transportation of Debris by Running Water. by Grove Carl Gilbert assisted by Edward Charles Murphy; quarto, paper covers, 260 pages, illustrated; U. S. Geological Survey, Washington, D. C.

Safety and Efficiency in Mine Tunnelling, by David W. Brunton and John A. Davis; 8vo, paper covers, 265 pages, illustrated; Bureau of Mines, Washington, D. C.

Mineral Resources of Alaska, Report on progress of investigations in 1913, by Alfred H Brooks and others; 422 pages. illustrated, U. S. Geological Survey, Washington, D. C.

Gold Fields of Nova Scotia, by W. Malcolm, compiled largely from the results of investigations by E. R. Faribault; 6½ by 9¾, 331 pages, illustrated, Canada Department of Mines, Geological Survey Branch, Ottawa, Canada.

Details of Cyanide Practice, by Herbert A. Megraw; 6 by 9¼, 215 pages, illustrated; $2.00; McGraw-Hill Book Co., Inc., New York.

Engineering Geology, by Heinrich Ries and Thomas L. Watson; 6 by 9¼, illustrated, 672 pages; $4.00, John Wiley & Sons, Inc., New York.

The Mineral Industry, Its Statistics, Technology and Trade During 1913, edited by G. A. Roush, 1010 pages, illustrated, $10; McGraw-Hill Co., Inc., New York.

Caspar's Technical Dictionary of the German and English Languages, compiled by C. N. Caspar; 264 pages, $1.00; C. N. Caspar Co., Milwaukee, Wis.

Alternating-Current Electricity, small 8vo, 534 pages, 389 figures. Cloth, $2.00. John Wiley & Sons, New York City.

Machine Shop Practice. By Wm. J. Kemp. 12mo., 199 pages, 163 figures. Cloth. $1.25. John Wiley & Sons, New York City.

Metallurgy of Copper, by H. O. Hofman. 556 pages, illustrated. $5.00. McGraw-Hill Book Co.

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An oil-fired copper blast furnace has been erected at the Copper King Mine at Chewalah, Wash. The exact mode of application of the oil is not yet made public. The furnace is supposed to have a capacity of 100 tons per day. The experiment is being watched with great interest by smelter men.

In iron smelting, "water-blocks", hollow castings let into the brickwork through which water is circulated, are extensively used. For the region immediatly above the tuyeres bronze has been found most satisfactory because the iron and slag do not burn fast to it. Bronze has also been used in the higher portions of the furnace walls, but recent practice has returned to cast iron as making a better union with the brick work and being less liable to burn out during a temporary failure of the water supply or a momentary rise of temperature.

The protection of the brick lining at the upper end of the blast furnace from abrasion by the charge dumped into the top has received much attention from iron metallurgists. Rings of cast iron set into the brick have been used. These expand under the influence of heat and the oxides of carbon and cause a distortion of the furnace top. Steel angle-iron and also aprons of sheet steel have been employed, but these are both subject to warping. The most satisfactory results have been obtained in recent practice from heavy wrought-iron angles, one flange being sunk nine inches into the brick the other flange, six inches in width, flush with the inner lining.

A new tube mill liner is being used at the McKinley-Darragh mill in the Cobalt district, Canada. Like the El Oro it consists of metal ribs with spaces in which the pebbles lodge, but the ribs extend around the inner circumference of the mill and not lengthwise. This liner is also used at the Holinger mill in the Porcupine district.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59.207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58.175	28.038	27.825	26.704
June	61.290	58.990	58.471	28.215	27.199	26.948
July	60.654	58.721	54.678	27.919	27.074	25.219
August	61.606	59.293	54.344	28.375	27.335	25.979
September	63.078	60.640	53.290	29.088	27.986	24.260
October	63.471	60.793	50.654	29.299	28.083	23.198
November	62.792	58.995	49.082	29.012	27.263	22.703
December	63.365	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.676	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14.672	61.603	14.871	.....	67.140	66.274
July	14.190	13.223	14.563	.....	64.166	64.955
August	15.400	.....	15.904	.....	69.200	53.227
September	16.328	.....	16.799	.....	73.125	.....
October	18.337	....	16.913	....	73.383	.....
November	15.182	11.739	16.022	.....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1913	1914	1913	1814
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.555
March	46.832	38.038	213.615	173.618
April	49.115	36.154	224.159	163 983
May	49.038	33.360	224.143	150 702
June	44.820	30.677	207.208	138 321
July	40.260	31.707	183.511	142.517
August	41.582	...	188.731	.....
September	42.410	32.875	193.074	.....
October	40.462	30.284	184.837	.....
November	39.810	33.304	180.869	139.391
December	37.635	...	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound sterling per long ton.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4 321	4.111	4 171	4.011	17.114	19.665
February	4.325	4.048	4.175	3 937	16.550	19.606
March	4.327	3.970	4 177	3.850	15.977	19.651
Apri	4.381	3.810	4.242	3.683	17.597	18 225
May	4.342	3 900	4.226	3.863	18.928	18 503
June	4 325	3 900	4.180	3.810	20.226	19.411
July	4 353	3.891	4 223	3.738	20.038	19 051
August	4.824	3 875	4.550	3.715	20.406	
September	4.698	3 828	4.579	3.658	20.648	
October	4.402	3 528	4.253	3 384	20.302	
November	4.293	3.683	4.148	3.585	19 334	18.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	6.931	5.262	6.854	5.112	26.114	21.583
February	6.239	5.377	6.089	5.227	25.338	21.413
March	6.078	5.220	5 926	5.100	24.606	21.460
April	5.641	5.113	5.491	4.963	27.313	21.569
May	5.406	5.074	5.256	4.924	24.588	21.393
June	5.124	5.000	4 974	4.850	22 143	21.345
July	5.278	4.920	5 128	4.770	20 592	21.568
August	5.658	5.568	5.508	5.418	20.706	
September	5.694	5.380	5.444	4.230	21.148	
October	5.340	4 909	5.188	4.750	20.614	
November	5.229	5.112	5.083	4.962	20.581	25.018
December	5.156		.004		21.214	
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

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MEXICO, D. F.

TRADE NOTES

The E. H. Moyle Engineering & Equipment Co. of Los Angeles, Cal is bringing out a small stamp mill for prospectors and others who have occasion to work on a very small scale. The mill is in principle the same as the battery of usual dimensions, but it is so small that it can be easily taken down by one man and transported by packing on mules or burros. The mill has one stamp, steel frames, automatic ore feeder and is driven by a 2 H. P. engine. One man can erect and run this little mill singlehanded.

The Traylor Engineering & Manufacturing Co., Allentown, Pa., has entered into a contract with the Knight-Christensen Metallurgical Co. and will manufacture and sell the patented apparatus used in the Knight-Christensen process.

The Allis-Chalmers Manufacturing Co., Milwaukee, Wis. has issued two new bulletins, one, No. 1088 is devoted to distributing transformers, the other, No. 1089, to reversing motor planer drives.

The Pelton Water Wheel Co., San Francisco, Cal., is distribuing a booklet in Spanish in which this standard motor is described together with much valuable information about installations and experience gained in hundreds of plants.

The Lidgerwood Manufacturing Co., New York, announces that during its 40 years of existence it has built more than 37,000 steam and electric hoists.

A double-drum Nordberg hoist, recently erected at the Jim Butler mine Tonopah, Nev. is equipped with the Balliet system of counter balancing. The gross load handled is 3900 lbs. of which 2600 is taken by the counter-balance. The balance furnishes a varying weight for all points of the cage's travel. It is claimed that by this means 70 per cent of the power is saved.

The Joseph Dixon Crucible Co., Jersey City, N. J. is sending out a postcard representing a barrel bearing an introduction to Dixon's Boiler Graphite, which is replacing boiler compounds, giving a smooth surface to the inside of the boiler shell and preventing the adhesion of scale.

The application of electrical power to the drive of machinery has done more than any other factor to put mining on the basis of other industrial enterprises. The economy of electrical drive is only one of its advantages. Its convenience and freedom from complicated shafting and other transmission gear, recommend it everywhere. Those who have not yet electrified their plants can secure estimates of costs and information as to the best methods of attacking their own power problems by applying to the engineering force of the Mexican General Electric company who have had experience in every phase of the mining industry.

Steam and air hoists are described in a bulletin issued by the Nordberg Manufacturing Co. The bulletin contains over 50 photographs and drawings, illustrating the design of the different types of hoists and of the principal details of construction. Chapters of unusual interest are those on compound condensing hoists, four cylinder hoists and air hoists. Another publication by the same company gives a description of the great hoist constructed for the Inspiration Copper Co., which has a total rope pull of 40,850 pounds.

The H. W. Johns-Manville Co., New York, is furnishing an acid-proof coating for tanks used in wet copper production. The material is called J. M. Acid Proof Mastic, and the basis is said to be pure natural asphalt.

P. H. & F. M. Roots Co., Connersville, Ind. has issued a series of catalogues descriptive of the company's manufacture. Cataloge 42 describes the Root line of blowers for smelting furnaces. Catalogue 46 treats of foundry blowers. Catalogue 48 is entitled Vacuum Pumps which illustrates and describes pumps for use in filtration in cyanide plants. Catalogue 47 gives in condensed form the full line of blowers, pumps and exhausters made by the company.

Gandy Belting Co., Baltimore, Md., has issued a 12 page pamphlet which sets forth the merits of "Oxylo" belting. Prices are listed of various widths and plys.

Hendrye & Bolthoff, Denver, Colo., has published a 12 page, illustrated, bulletin descriptive of the Leadville drill-column hoist, which is a small hoist operated by a steam or compressed air operated engine. It can be quickly moved to any part of the mine where needed.

Dorr Cyanide Machinery Co., Denver, Colo., has issued Catalogue No. 5 which illustrates and describes the Dorr Classifier, Dorr Continuous Thickener and the Dorr Agitator, all of which machines are well known in Mexico.

The Monterrey Steel Co., Monterrey, N. L., anticipates an unprecedented demand for steel rails to be used in reconstructing the railways of Mexico which were damaged during recent revolutions.

Dr. L. B. Hoit, special commercial agent of the United States Bureau of Foreign and Domestic Commerce of the Department of Labor, conferred with manufactures in western Pennsylvania last week to acquaint producers with requirements of consumers in Mexico. Dr. Hoit, who has made a study of commercial, financial and industrial conditions in Latin America, says that Mexico is the land of tomorrow.

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Progreso de la Metalurgía del Cobre y del Plomo en el Año de 1913.

Es conveniente hacer balance periódicamente de los adelantos de las industrias, mereciendo reseña muy especial la metalurgia, en la cual tanto se trabaja en fábricas y laboratorios, lo que nos induce a tratar en este artículo de los progresos de la del cobre durante el año de 1913.

Cobre

Aparatos.—En la metalurgia del cobre han continuado mejorando los aparatos, o extendiéndose el uso de otros; así, en el tostado de los sulfuros, los de Dwight-Llyd y otros semejantes; en los hornos de fusión han seguido los de cuba, casi sin modificaciones, y los de reverbero no han pasado de los 35 metros de longitud; antes bien, han retrocedido, pues se supone que deben ser de 30 a 33 metros como máximum para el mejor efecto. Continúa aprovechándose el calor de los gases perdidos en levantar vapor; pero la solera se ha formado de magnesita, y en algún caso se han blindado; se ha extendido el uso del carbón en polvo, introducido por el viento para su calefacción, y disminuye el número de los calentados por petróleo, a causa del encarecimiento de dicho combustible.

En los convertidores, casi han desaparecido los de revestido ácido; empezándose en estos últimos a introducir la sílice para escorificar el hierro de la mata, evitando que la suministre la camisa, o haciéndolo ésta en pequeña cantidad, lo que permite que dure más; en los básicos se han llegado a tratar en algunos de ellos, sin parar la marcha, 1,200 toneladas, aunque los haya que han debido ser desmontados para repararles la camisa a los pocos días. Para remediarlo, los señores Wheeler y Kreji han sacado privilegio para recubrirlos con revestimiento monolítico de de magnetita, formado introduciendo en el convertidor mata de 35 por 100 Cu y soplándola; como no tiene sílice, no se escorifica el hierro y se convierte en Fe_3O_4 que recubre las paredes y resiste sin fundirse hasta unos 1,500° C., y según va disminuyendo la mata, se añade hasta que se ha conseguido gradualmente el espesor deseado.

Al hablar de los convertidores básicos, parece justo y hasta curioso citar las lamentaciones de Baggaley, que atribuye los descubrimientos de Pierce y Smith, de convertidores de camisas básicas, el procedimiento de fusión pirítica de Kundsen, los de Wheeler y Kreji y el tratar los minerales silíceos cupríferos por imbibición, en mata fundida directamente en convertidor, a sus trabajos en Butte por el año 1905, y que consistieron en fundir piritas de hierro auríferas sin cobre en horno de cuba, con camisa de agua, introducirla líquida en convertidor vertical de acero, revestido de magnetita, y sobre ella la mena silícea cúprica; consiguiendo obtener cobre durante bastante tiempo, si bien es cierto que no resultaba económico. Lo hubiera sido si la mata se obtuviera en el horno de cuba, ya bastante rica en cobre para tratarla en el convertidor.

En cuanto a la forma de los convertidores, parece dominar la idea de ser los más a propósito los verticales, es decir, cilíndricos, con altura casi igual, o igual, al diámetro de la base; esto se deduce de la práctica verificada en Great Falls, en donde, según Wheleer y Milo W. Kreji, se ha llegado a las conclusiones de que el revestido básico es mejor que otro pequeño, aconsejándose sustituir varios pequeños por el menor número de grandes; las toberas para convertidores de 3,60 metros a 6,60 metros de diámetro, deberán tenerlo de 0,055 metros; las bocas del convertidor serán grandes; el revestido del fondo estará algo alejado de la busa unos 0,12 metros, por la tendencia a crecer que tiene, y que perjudicaría; la altura del convertidor vertical será de unos 4 a 5 metros.

En los hornos del refinado se ha continuado con los grandes; empleando en ellos para la solera la magnesita y cromita, suprimiéndose con esto la gran cantidad de escorias ácidas que se producían, y que llevaban mucho cobre, el que tenía que tratarse de nuevo.

Hidrometalurgía.— La gran cantidad de menas silíceas pobres en cobre existentes en los Estados Unidos, ha hecho que se haya tratado de aprovecharlas, disolviendo el cobre, separándolo de las gangas insolubles por filtración y precipitando el cobre disuelto. Hace años se trabajaba por encontrar un procedimiento parecido al de la cianuración del oro, sin conseguirlo; pero el año pasado han aparecido más de una docena de fábricas que han montado instalaciones de levigación, con resultados buenos, al parecer.

El disolvente suele ser el ácido sulfúrico diluido, que disuelve bien el cobre, con algo de hierro y alúmina, sin gastar mucho ácido; las menas oxidadas sin exigir el tostado, las sulfuradas con calcinación previa; las que contienen plata se cloruran, añadiendo sal a la solución. En la fábrica de Shanon tuestan los minerales oxidados y muy básicos con piritas, sulfatando el cobre, y vierten sobre los montones del mineral el líquido residual de la cementación.

Para precipitar el cobre de las soluciones, emplean la corriente eléctrica, con ánodos insolubles, a veces de magnetita fundida, haciendo atravesar el electrólito una corriente de anhídrico sulfuroso, para lograr un menor gasto de energía. También se utiliza la cementación con hierro obtenido de los residuos de piritas descobrizados. mezclados con carbón y calentado todo en horno cerrado, a una temperatura de unos 900° C.; si contuviera la materia mucha ganga, se podría quitar por separación magnética.

J. W. Richards aconseja colocar el hierro de cementación sobre planchas de cobre, y así se desarrolla corriente que transporta el cobre cementado sobre la plancha, dejando el hierro libre de él.

Para la lixiviación, emplean las cubas de cianuración o semejantes, citándose las de Chuquicamata, que contienen casi 10,000 toneladas, teniendo 4,9 metros de profundidad, 30,6 metros de ancho y 45,75 metros de largo; y se aconsejan como buenas las de Parral, de agitación por aire, totalmente de madera y con válvulas de vidrio o loza, menos atacables por los ácidos.

Publicaciones.—El doctor E. Weintraub leyó en la reunión del Am. Institute of Metals, en Búfalo, los días 24 al 27 de septiembre, un trabajo sobre los adelantos del tratamiento del Cu con boro: explicando dos procedimientos para tener el boro, uno reduciendo el anhídrido bórico por Mg y purificando el metaloide así producido de 98 por 100, en horno a propósito; en el segundo reduce el tricloruro de boro puro, con H puro.

El boro muy puro se fundirá en horno eléctrico revestido de su nitruro; por la gran inonidad del metaloide para casi todos los elementos, menos para el cobre, aun fundido, le desoxidará, resultando cobre de 94 por 100 de conductividad eléctrica de Matthiessen.

El subóxido de boro se obtiene por reducción del anhídrico con el Mg-Al, o metal alcalino, y por subsiguiente tratamiento de los productos; el anhídrido en exceso y el borato producido, no perjudican el tratamiento; más bien le favorecen, dividiendo el subóxido. Se usan 0,75 a 1 por 100 que contienen 0,08 a 1 por 100 de subóxido.

Puede también utilizarse toda substancia menos oxidada que el anhídrido; el carburo de boro u otro; y en todo caso, para auxiliar la reacción, se recalentará el cobre. En Lyun, la General Electric Co. emplea calderas de 56,7 kilógramos, e introduce el boro auxiliar mezclado con carbón vegetal, y el cobre encima, fundiéndose hasta alcanzar la temperatura deseada, sin exceder; se retira el caldero, se quita la escoria, se echa el resto del boro auxiliar, agitando la masa; pasado un minuto, se desescoria y se enfría el metal a la temperatura del moldeo.

En Schenectady se usa el reverbero, introduciendo en el fondo el boro auxiliar y después el cobre, agitando con aparato de grafito Acheson, sin empleo de hierro, para no perjudicar al metal, que llega a conductividad de 97 por 100 de Mathiessen; empleando metal viejo no se alcanza esa cifra. La resistencia a la tracción llega a 17 kilógramos por mm2; límite de elasticidad, 8 kilógramos por mm2; expansión, 48,50 por 100; con las ventajas del cobre moldeado, no sólo de ser más barato, sino en muchos casos de obtener mejores aparatos y de la posibilidad de combatir pérdidas en el efecto útil; en transformadores se puede economizar espacio.

En el cuaderno 16 de Metall und Erz, publica el señor Fiedrich Huser un artículo sobre la refinación del cobre con magnesio, demostrando que después de varias fusiones con él, tiene el máximum de conductibilidad. En artículo posterior le compara con el refinado mediante otras substancias; unas más caras, como el boro y el titano, y otras que dejan oxígeno, que forma óxido cuproso. El hidrógeno y azufre en el cobre, aumentan mucho en volumen; el fósforo y el sílice obran desfavorablemente sobre la conductividad eléctrica, y en parte el manganeso y el cromo. El aluminio forma la muy perjudicial alúmina; y el hierro, el níquel y el titano, endurecen el cobre, dificultando su estirado, lo que más en grande hacen el zinc y el estaño.

El autor añade cupromagnesio con 20 por 100 Mg en cantidad de 0,125 a 0,50 por 100 sobre el cobre fundido, preferentemente en horno eléctrico, cubierto de carbón vegetal; se berlinga con pértiga de madera y se forma capa de magnesia de 0,02, que se retira, y queda el cobre con algo de magnesio, pero sin oxídulo ni gases, denso y tenaz, de testura sedosa, sin azufre, que se le quitó, y elevándose menos en el molde cuanto más magnesio tiene. Al enfriarse en el molde, se contrae 1|61, y pudiendo los moldes ser de hierro, untados de grafito.

Este cobre se lamina y estira bien, teniendo el alambre 42 kilógramos de resistencia, con conductividad eléctrica de metal puro, habiendo elevado ésta el autor desde 97,1 a 98,5 por 100, refinando el cobre con Mg.

Von E. H. Stek publica en Metall und Erz, cuaderno 22, año 1912-13, un trabajo sobre los hornos empleados en la obtención y refinación del cobre, recomendando los de gas, y en la refinación los basculables, con gran cuidado en la elección de gasógenos.

En lo referente al tratamiento de minerales de este metal, han publicado los señores Fritz Caspari y Alfredo Flegel, en el cuaderno 9 de Metall und Erz, trabajos sobre fusión independiente de minerales oxidados cupríferos, pobres y ricos en sílice y cal, llegando a las conclusiones siguientes:

I. El mineral triturado puede enriquecerse hasta tener 50 por 100 Cu, aumentando también la cal.

II. El mineral puede tratarse por levigación, excluyendo los ácidos por medio de disoluciones de sales ácidas y de determinados álcalis, especialmente sales amoniacales o amoniaco, y con subsiguiente electrolisis, según condiciones económicas.

III. Los resultados mejores se obtienen por el tostado y reducción, unidas a la preparación húmeda, que dará menas ricas en Cu, otras pobres y residuos calizos.

Entre los trabajos sobre lo mismo, con aplicación de la corriente eléctrica, por sus efectos térmicos, recordamos el publicado en Transactions of the American Institute of Mining Engineers, de agosto de 1913, de cuyo trabajo tomamos lo siguiente:

Se fundieron electrotérmicamente minerales que tenían 37,35 y 25,35 por 100 de cobre nativo de Michigan, en forma de finos, obteniendo estas conclusiones:

1a. Se obtiene cobre negro de 98,59 por 100 sin pérdidas excesivas de cobre de tales menas;

2a. La proporción de cobre de la escoria no excedía de 0.25 por 100 y de 0.50 por 100 del cobre cargado, y no siendo las demás pérdidas superiores a 1 por 100, no pasaban éstas del 1,50 por 100 del cobre cargado;

3a. La pérdida de Cu por volatilización es alta y crece con el grado de acidez de la escoria, a contar del monosilicato, y con mucha alúmina; es la mínima para la escoria, compuesta de 35 por 100 SiO2 22 CaO y MgO y 25 FeO;

4a. La diferencia entre la eficacia de castina o hematitas, como flujo, es pequeña, dependiendo en parte de la mayor densidad que den a la escoria, siendo el hierro del cobre negro el mismo con uno o con otro flujo;

5a. Con horno marchando a la baja temperatura, necesaria para escoria monosilicatada, se obtendrá cobre de más de 95 por 100; y con marcha cuidadosa de 98 por 100, sin exceso de metal, reducido por el carbón de los electrodos.

6a. El gasto total electródico excede mucho al del carbón necesario para la reducción del hierro que acompaña al metal cobre, empleando término medio 9,35 por 100 en la reducción del Fe; el del gasto total fué de 4,54 kilogramos por tonelada de carga;

7a. El horno eléctrico trabaja bien con escoria aluminosa, rica en sílice, producida por la ganga sola, sin flujo, y perdiendo mucho cobre volatilizado por la gran temperatura necesaria para liquidarla; el cobre producido no contiene óxido de este metal.

8a. El consumo de fuerza para los dichos concentrados de riqueza en Cu de 25 a 40 por 100 en horno eléctrico de 750 kilovatios no excede de 640 kilovotios-hora por tonelada, de mena fundida.

En los ensayos en horno pequeño, obtuvieron cobre con 1,10 por 100 Fe, y escoria con 1,37 por 100 Cu, debido en parte a acompañar en la última, mena fundida. La operación fué contínua, cargando el horno a intervalos por el tragante de la cuba pequeña, destinada a calentar la carga, antes de llegar al crisol, el cual tenía dispuesto el bigote para sangrar la escoria de un modo contínuo y sin canillero.

Los autores proponen un tipo de horno de energía eléctrica, con capacidad bastante para la separación del metal y escorias, y la cuba pequeña en donde se calienta la carga; dos muros son de ladrillo refractario y lleva tres electrodos, para corriente trifásica de 50 a 100 voltios, regulables a mano y colocados verticalmente. El horno de 750 kilovatios tratará en veinticuatro horas 23 toneladas de concentrados con 25 a 40 por 100 Cu, siendo las ventajas del tratamiento electrotérmico las siguientes:

1a. No se requiere aglomeración previa; 2a. Las escorias no necesitan nuevo tratamiento; 3a. Gran cantidad de concentrados ricos de 75 por 100 Cu, se mezclarán en la carga sin necesidad de usar tantas escorias; 4a. Con fuerza barata, podrían tratarse escorias cupríferas, obteniendo cobre con poco hierro, y escorias con poco cobre, por la gran facilidad de regular la atmósfera reductora, necesitando sólo el coke necesario para reducir el Cu.

La mezcla de concentrados ricos y material fino determinará la conductibilidad eléctrica en el horno. En las experiencias no encontraron los autores dificultades debidas a cortos circuitos u otras causas, en mezclas con 37 por 100 Cu.

La fusión eléctrica dependerá del precio de la corriente y del combustible, siendo la del último opuesta a la de la

primera, como también la de la aglomeración y mano de obra. Si la mina pagara grandes arrastres hasta la fundición, podría ser más barato fundirlos en ella eléctricamente, después de concentrarlos por vía húmeda, siempre que en esta concentración no hubiera grandes pérdidas, pues en tal caso no se llevaría a tan altos límites; la fusión eléctrica daría cobre más impuro, pero de gran riqueza, que se vendería a las fundiciones para su refinación.

Se tendrá en cuenta que en reverberos habrá que tratar de nuevo el 81 por 100 del material cargado, con escoria, mientras que en el horno eléctrico lo será el 5 por 100.

Fusión de las menas de cobre en horno de cuba.—Se sabe que en el tratamiento ordinario de los sulfuros de cobre en hornos de cuba, se exige primero el tostado o expulsión del azufre en casi su totalidad, y la reducción por el carbón de los óxidos formados; la cuba está ocupada por el combustible en gran parte, de modo que el aire inyectado pierde el oxígeno, unido al carbón incandescente. Los sulfatos y algún sulfuro existentes pueden también reaccionar con los óxidos de cobre y producirse así algún metal. Poco azufre será oxidado por el oxígeno del aire, el que se supone no llegará al 5 por 100.

Las pérdidas en este procedimiento proceden, 1.°, del polvo de mena arrastrado por el viento cada vez que se verifica la carga; 2.°, del polvo llevado por el viento a las cámaras; 3.°, de la volatilización; 4.°, del arrastrado en las escorias, ya sea mecánicamente o combinado. Empleando el horno eléctrico, las pérdidas de arrastre de polvo por el viento se suprimen, quedando las de los gases, aunque no en tanta escala. Las de volatilización podrán ser mayores en la base de la cuba, pero en el ascenso por ella se depositarán, resultando menores. Las escorias tampoco llevarán tanta parte útil, por ser más regulable el horno eléctrico, suministrando mejor el calor, liquidando más la escoria, separándola de la mata o metal, y los metales oxidados serán nulos o insignificantes, puesto que no se introduce aire.

Experiencias sobre fusión eléctrica de menas sulfuradas.— Trabajaron los autores en el **Bureau of Mines Laboratory**: 1.°, en determinar las condiciones de la fusión meramente eléctrica de los minerales; 2.°, en ver el tanto por ciento de concentración y azufre desaparecido; 3.°, estudiar la posibilidad de condensar el azufre; 4.° determinar el consumo de fuerza con cargas distintas; 5.°, determinar las pérdidas de oro, plata y cobre; 6.°, estudiar el uso de mata pobre en cobre, como colectora del oro y la plata.

Emplearon menas sulfureas pobres en cobre, otras silíceas con oro y plata, y alguna tostada, de las composiciones adjuntas. La caliza era de 63,2 por 100 CaO y 5,7 por 100 MgO.

Las menas se trataban en el horno eléctrico cerrado descrito antes, para evitar escapes de azufre y entradas de aire por el techo, y en comunicación con el condensador, compuesto de tres cámaras horizontales prismáticas, con varias divisiones para recoger el azufre y los humos.

Conclusiones:

1a. En la fusión de menas sulfurosas en horno eléctrico se obtendrá la volatilización de 60 por 100 de su azufre, y la separación de la mata y escoria.

2a. La proporción de concentración de 10 por 100 de azufre, más un átomo, pero no desaparecerá hierro, por no haber oxígeno en el horno para oxidarlo y escorificarlo.

3a. Cualitativamente es posible recoger algún azufre condensado.

4a. Mata de 1 por 100 Cu de carga de 0,30 por 100 Cu, es buena colectora del oro y plata si la separación de la mata y escoria ha sido ejecutada.

5a. La pérdida de cobre, por volatilización y en la escoria, es pequeña.

6a. Hay poco oro perdido por volatilización; es menor el de la plata; lo que no ocurrirá, probablemente, en horno grande bien regulado.

7a. El consumo de electrodos en la fusión de menas sulfurosas no excederá de 2,5 kilógramos por tonelada de carga.

8a. En horno comercial grande, el consumo de fuerza para casi todas las menas será de unos 480 kilovatios-hora por tonelada de mena, 0,055 kilovatios-año.

En cuanto a la comparación entre el horno eléctrico y los de reverbero y de cuba, para las menas de cobre, afirman los autores:

1o. La fusión de sulfuro, óxido o cobre nativo, puede verificarse tan bien o mejor en el horno eléctrico como en cualquiera de los otros dos.

2o. Lo mismo sucede en cuanto a las reacciones de la fusión.

3o. La pérdida de electrodos varía de 2,5 kilógramos a 5 por tonelada de mena tratada; no causando el carbón de ellos reducción perjudicial de hierro, o consumo apreciable de energía eléctrica.

4o. Las pérdidas de Cu, Au y Ag no llegarán a las de las investigaciones dichas, ni a las de la fusión en hornos de reverbero o de cuba.

5o. Mata de 1 por 100 Cu podrá usarse como colector de oro y plata, tanto en horno eléctrico, como en los de combustión.

6o. Los costos comparativos dependerán de la clase de mena, de los del carbón y energía eléctrica, necesitando de 500 a 700 kilovatios-hora por tonelada de carga para fundirla.

Costos.—Suponen los autores, que cuesta la fundición eléctrica lo mismo que la ordinaria de igual capacidad, y que se pueda comprar energía a otra compañía, o si la hace la fundición, se considere como negocio aparte, en cuyo caso, dicen, habrá que añadir el costo de transformadores, conductores, instrumentos, etc., y que el horno ha de fundir 384 toneladas inglesas de carga, siendo la composición de ésta:

Cu	5,21
$Si O_2$	26,41
Fe O	18,60
S	11,46
$Al_2 O_3$	4,26
Cu O	17,49

Composición y carga tratada varios meses en Washoe, Anaconda, con 8,2 por 100 de cok. Veamos la energía requerida.

Puesto que se empleaban 8,2 por 100 de coke, tendríamos $\frac{2.000 \times 8,2}{100} = 264$ libras de coke, que tenía 80,24 por 100 de carbón fijo; por lo tanto, su carbón equivalía $\frac{164 \times 80,24}{100} = 131,59$ libras, y siendo la potencia calorífica de la libra de esta substancia 8.100, tendremos $131 \times 8.100 = 1.061.100$ por conversión del carbón en dióxido.

El kilovatio-hora 1,897 libras calorías; se requerirán $\frac{1,061.100}{1.897}$ o 559 kilovatios-hora para reemplazar las 164 libras de coke, pero suponiendo la menor eficacia del horno de cobre de 50 por 100, la energía obtenida del coke en él será de 350,550 calorías, representado teóricamente por $\frac{530,550}{1,897}$ o 280 kilovatios-hora por tonelada. Considerando la eficacia del horno eléctrico de este tipo de 85 por 100, y aun rebajada a 70 por 100, los 280 kilovatios-hora se aumentarán 1,42 veces, y serán 280 por 1,42—397, o sean 400 kilovatios-hora para fundir la tonelada de carga, y teniendo en cuenta el calor desarrollado por la combustión del azufre, no está el número último lejos de los 480 kilovatios-hora calculados para la sola fusión. Como hay que fundir 10 toneladas por hora, 400×16—6,406 kilovatios-hora será la carga constante sobre el horno, y como el suministro de fuerza será trifásico, el equipo eléctrico se compondrá de tres transformadores de voltaje variable, para dar margen amplio a las sobrecargas repentinas, instrumentos, cables, etc.; el costo de lo cual dependerá de la localidad y otras circunstancias.

Costo de la fusión.—Según los autores, el coke y la energía eléctrica son casi iguales; cuando el primero cuesta $7 por tonelada, la segunda $0.15 por kilovatio-hora, o $13 por kilovatio-año; relación de 1:1,8, y no tienen en cuenta las ventajas de la fusión eléctrica, sino solamente el costo de electrodos y de la energía, que equivalgan al coke que produzca igual efecto.

En Trolhatan, Suecia, 10 libras de electrodos se requieren por tonelada de hierro, o aproximadamente 5 libras por tonelada de carga, valorado en 0,30, aunque es llegado a 2 libras por tonelada, en cuyo caso la suma del costo de energía eléctrica y electrodos no superará a la del coke, valiendo $9 tone-

lada, la energía lo sería de 9×1,8—$16,20 el kilovatio-año, menos costo de electrodos, o sean unos $16.

Basándose en las calorías y coke de 84,24 de C. fijo, la tonelada de 2,000 libras tendrá 1,604,8 libras de carbón, que convertido en CO_2, darán 13,000,000 calorías; el kilovatio-año es igual a 16,616,000 calorías; luego se requerirán 1,2 toneladas del coke citado, que habrá que elevar a 1,5 ó 1,8 toneladas por faltas en la combustión.

En la fusión pirítica, creen los autores muy aplicable el horno eléctrico, suministrando la corriente eléctrica el calor que proporcionaba la pequeña cantidad de coke usada en el horno ordinario, aumentando o disminuyendo el calor, según las necesidades, y sosteniendo la concentración constante, cosa no fácil, empleando combustible.

En resumen: en la fusión de las menas cobrizas, el horno eléctrico no será el competidor de los de carbón, sino substituído en casos especiales, como ha sucedido con los de hierro, aunque en condiciones más ventajosas para los de cobre. Se tendrá en cuenta el menor costo cada vez de la fuerza eléctrica, por las mejoras en las máquinas de gas y turbinas de vapor, de modo que en distritos abundantes en carbón, aunque malo, podrá éste emplearse para producir electricidad.

En la discusión de este trabajo intervino Mc A. Johnson, con un escrito en el cual daba los datos obtenidos en la fusión de menas de zinc, complejas, teniendo plomo y cobre. En la fábrica Hartford, de la Continuous Zinc Furnace Co., durante catorce meses, en 114 sangrías, se obtuvieron eléctricamente 16,9 toneladas, con escorias de contenido en cobre muy bajo, 0,065 por 100, 7.05 Pb, 0,50 onzas Ag y 0,01 Au; en junio de 1913 se repitió la operación con carga de 0,43 por 100 Cu, dando mata de 5,33 por 100 y escorias de 0,05 por 100 Cu.

Las condiciones para la remoción del cobre retenido en las escorias, bien sea por acción química, como silicato o disuelto como sulfuro, o bien en suspensión, como partículas de mata, se clasificaron así:

1. Escoria delgada líquida, recalentada; son líquidas de 1,100° a 1,200° C. y se sangraban de 1,250° a 1,350° C.

2. Baño tranquilo alterado por 60 pulsaciones por segundo de la corriente alternativa.

3. Interna relación de la zona de fusión, que reduce 272 kilogramos a 454 kilogramos de óxido de zinc por tonelada de carga.

Cada condición de las tres, explica la separación del cobre de la escoria, y es de esperar que en condiciones de fuerza favorable y con carbón muy barato, se pueda llegar a consumir por tonelada de carga fundida, menos de 300 kilovatios-hora, y de electrodos menos de 2,5 kilógramos.

Fusión pirítica.— En este procedimiento de obtención del cobre, efectuado generalmente en horno de cuba, el aire o su oxígeno no se dedican a oxidar el carbón, sino al hierro y al azufre de la carga, en su mayor parte, y de ello resultan:

1o. La expulsión del azufre.

2o. La oxidación del hierro, combinado con el azufre expulsado.

3o. La escorificación del hierro oxidado y su separación de la mata obtenida.

Muchos autores diferencian la fusión pirítica de la semipirítica, según que el carbón no llegue al nivel de las toberas, o sea menos del 3 por 100 de la carga, o que llegue a dicho nivel, y estará comprendido entre el 3 y el 10 por 100 de ella.

Lixiviación y Precipitación Electrolítica del Cobre en Chuquicamata.

* Traducido del "Mining and Scientific Press."

La mina de cobre "Chuquicamata" está en Chuquicamata, estación de un ramal del ferrocarril de Antofagasta a Bolivia, en la provincia de Antofagasta. Chuquicamata dista 165 millas por ferrocarril de Antofagasta, y 82 millas en línea recta de la costa, estando a la altura de 9,500 pies sobre el nivel del mar. Desde hace mucho tiempo, al yacimiento se le conocía como el depósito de atacamita de Chile, y desde hace mucho fué trabajado por los nativos del país. Como prueba de esto, se encuentran en los trabajos antiguos muchos utensilios de piedra, tales como martillos, etc.

El depósito consiste en brochantita, la que está contenida en los clivajes de la grandiorita, mezclada en parte con chalcantita y también con atacamita, y todo está asociado a un depósito de sal. En la parte superficial del depósito se encuentra también algo de caliche.

Este depósito, llamado los llamperos, se extiende en una distancia de 8,000 pies, con un ancho medio de 500 pies. Perpendiculares al largo del depósito, se han abierto numerosas galerías y grandes cantidades de mineral se han dejado en los desmontes provenientes de estos túneles. Desde las galerías se han hecho chimeneas a la superficie, y hay partes en que el cielo de éstas sólo tiene 8 a 12 pulgadas de espesor. También se han construido varios piques a través del depósito, llegando el más profundo de éstos a 110 metros.

Adquisición y reconocimiento de la pertenencia

El yacimiento fué adquirido por Alberto C. Burraje, de Boston, quien con los señores Guggenheim e hijos, formaron la "Chile Exploration Co.," y el yacimiento pertenece actualmente a esta compañía. El yacimiento se ha reconocido con sondas de percusión, con lo cual se ha determinado la existencia de más de 200.000,000 de toneladas de mineral. Muchas de las perforaciones se pasaron cuando aún los planes estaban en mineral.

La corrida media del mineral es de Norte a Sur. Ultimamente se han ejecutado un cierto número de sondajes a diamante, a considerable distancia, al Oeste de los llamperos y después de atravesar 300 a 400 pies de terreno, se ha encontrado nuevamente chalcocita y chalcopirita, lo que asegura que el tonelaje previamente dado, se aumenta materialmente. De los 200,000,000 de toneladas reconocidas en la zona de los llamperos, dos tercios son de brochatita y un tercio de sulfuros. No se ha reconocido cambio en la formación, aun en los sondajes más profundos, pues siempre el mineral se presenta en el clivaje de la granodiorita. Las perforaciones más profundas quedan siempre en el mineral primitivo. Por la cantidad de mineral reconocido e indicado, parece que la mina Chuquicamata es probablemente el depósito de cobre más grande que actualmente se conoce.

Es creencia general que este grande y bien conocido depósito estaba formado por atacamita, y como tal, no podía trabajarse con beneficios por alguno de los métodos ya conocidos, primero, a causa de lo muy silíceo del mineral y la falta de sulfuros y de agua; y segundo, a causa de la volatibilidad del cloruro de cobre en la fundición. Se demostró que el mineral no era atacamita (oxicloruro de cobre), sino brochantita (oxi-sulfato) y que mezclado con la brochantita en la parte superior había un depósito de sal. Siendo la brochantita un oxi-sulfato de cobre, es insoluble en agua, pero fácilmente se disuelve en ácido sulfúrico diluido. Por tanto, quedaba demostrado que el procedimiento para tratar el depósito de brochantita debía ser un proceso de vía húmeda.

Experimentos preliminares

Para experimentación en pequeña escala, se enviaron a Nueva York unas 600 toneladas de mineral, que fuesen una muestra representativa del mineral contenido en el depósito. Al principio las pruebas se hicieron en muy pequeña escala y gradualmente, así que los resultados fueron prometedores, se fué aumentando la escala de experimentación y se llegó a tratar dos toneladas diarias. El término medio de la ley en cobre del mineral así tratado, fué de un 2 por ciento. Los principales problemas que se presentaban para resolverlos eran los siguientes: 1, la solubilidad del mineral de cobre en ácido sulfúrico; 2, la cantidad de reactivo necesario como disolvente; 3, la cantidad de impurezas que entrarían en la solución, y 4, la precipitación del cobre de la solución obtenida.

Los primeros pasos en la resolución de estos problemas, pueden resumirse así:

1.—**Solubilidad del mineral.**—Las experiencias hechas en pequeña escala pu-

sieron de manifiesto que el mineral era fácilmente soluble en ácido sulfúrico diluido y frío, y que sólo era necesario una molienda más o menos gruesa.

2.—**Reactivos necesarios.**—Después de prolongadas experiencias, se comprobó que el mineral daba suficiente ácido sulfúrico, proveniente de la descomposición del sulfato de cobre contenido en la brochantita, para compensar las pérdidas de ácido sulfúrico habidas en el procedimiento. Las pérdidas de ácido dependen, principalmente, de dos causas: primera, pérdidas debidas a que el ácido disuelve otras substancias, además del cobre del mineral, y segunda, por el arrastre de solución por las lamas.

3.—**Impurezas que entran en la solución.**—Experiencias, largas también, han demostrado que no se acumularán muchas impurezas perjudiciales en la solución, fuera del cloruro proveniente del depósito de sal mezclado al mineral en la parte superior del yacimiento.

4.—**Precipitación del cobre.**—Las experiencias efectuadas en nuestro establecimiento de ensayes han demostrado de un modo concluyente que de la solución con ácido sulfúrico se puede obtener un cobre electrolítico de excelente calidad.

Lixiviación experimental

Después de terminar un cierto número de pruebas de lixiviación en la escala, capaz de hacerse en un laboratorio, y después de experimentar repetidas veces con 100 kilos de mineral cada vez, se hicieron experiencias en mayor escala y se concluyó una planta para tratar dos toneladas de mineral por día. En esta planta se han tratado 131 cargas de mineral, y se ha manipulado enteramente como si fuese una unidad de trabajo; lixiviando el mineral lavándolo, purificando y electrolificando las soluciones obtenidas y lixiviando la carga siguiente de mineral con la solución proveniente de la electrolificación de la solución de la carga anterior.

En esta planta se trataron minerales que representaban el carácter general del mineral oxidado de Chuquicamata; unos altos en cobre, otros bajos; unos abundantes en impurezas, otros pobres; y suficientes pruebas se hicieron para experimentar el método con minerales ricos y pobres. También se experimentó con minerales que contenían gran cantidad de sal y otros poca. pues ésta es la principal impureza del yacimiento. Sin embargo, el depósito de sal sólo llegó hasta los 50 pies de profundidad, siendo su acción más marcada en los primeros 25 pies.

A fin de estar seguro que el método es aplicable aún en las condiciones más adversas, la misma solución se empleó continuamente en el tratamiento de las 131 cargas de mineral, y sólo se separaba solución para impedir un exceso de ácido. Después se hizo un análisis completo de esta solución, y dió el siguiente resultado:

	Gramos por litro.
Cu	50.44
Fe	3.71
Mu	0.07
P	0.06
As	nada
Sb	nada
Ca O	0.80
Mg O	3.32
$Al^2 O^3$	1.61
$Na^2 O$	21.60
K^2O	5.05
$S O^3$	122.75
Cl	11.52
Acido libre (como $SO^4 H^2$)	28.00
Total de sólidos después de ignición	189.40
Acido nítrico	4.00

Los resultados obtenidos con la solución con que previamente se trataron 131 cargas de mineral, fueron tan buenos como los obtenidos con la solución preparada con ácido sulfúrico y agua. En otras palabras, se ha comprobado que las impurezas acumuladas no tienen ninguna acción en los resultados obtenidos. La extracción media obtenida en esta planta de dos toneladas fué de 90.99 por ciento.

Después de las experiencias efectuadas en esta planta de dos toneladas, se construyó una tina de concreto para la lixiviación; dicha tina se revistió con asfalto. La sección fué de 4 por 6 pies y 15 pies de profundidad, capaz de contener 15 toneladas de mineral; con esta profundidad se consiguió tener el mismo espesor de mineral que tendrán las tinas que actualmente se construyen en Chuquicamata. (Véase Mining and Scientific Press, abril 11, 1914, p. 620). La cuestión que había que resolver era si sería posible lixiviar el mineral en tanques de dicha hondura. Experiencias intensivas confirmaron plenamente los resultados obtenidos en tanques más pequeños.

En los tanques de dos toneladas se censtruyó un filtro de madera, cubierto con una capa de cocoa, y en las tinas de 15 toneladas se hicieron muchas experiencias, sin poner ningún filtro en el fondo, y sólo se dispuso un pedazo de tela de cocoa en la cañería de salida. Las pruebas se hicieron sin ayuda de calentamiento. El lavado del mineral se hizo por el método llamado de "pistón," se dió un lavado final con agua, y los tailing descargados contenían un término medio de 12 por ciento de humedad y un 0.01 por ciento de cobre soluble en agua.

Extracciones obtenidas

Los resultados hasta la fecha obtenidos de las lixiviaciones son los siguientes:

	Por ciento.
La extracción media obtenida cuando se trataban lotes de 100 kilos c'u, fué de	90.62
La extracción media de las 131 cargas en la planta de 2 tons.	99.99
La extracción media en el tanque de 15 tons., en que se han tratado 25 cargas, fué de	90.96

Estos resultados están basados en el peso y muestra del mineral antes de ponerlo en el tanque, y en el peso y muestra de los residuos descargados de las tinas.

Combinando todos estos resultados, y tomando el contenido en cobre en el peso y muestra del mineral tratado, y determinando después el cobre electrolítico producido como cátodo, y considerando también el cobre contenido en la solución al estado de sulfato de cobre, la extracción fué de 89.6 por ciento.

Cantidad de reactivos necesarios

Después de haber subministrado la cantidad de ácido sulfúrico necesario para iniciar la operación, no sólo se determinó que era innecesario agregar más ácido, sino que se producía un exceso de ácido, a causa del ácido sulfúrico contenido en el mineral mismo, de modo que aproximadamente se tenía una ganancia de 9 lb. de ácido ($H_2 S O^4$) por tonelada de mineral tratado. En otras palabras, sería necesario eliminar una parte de solución, equivalente a esta ganancia en ácido para impedir que el ácido se acumulase durante el proceso. Este exceso de ácido se obtuvo al tratar mineral con un contenido en sal superior al que tienen los minerales de las capas superiores del yacimiento de Chuquicamata. Y como la mayor pérdida en ácido sulfúrico se debe a la formación de sulfato de sodio, creo que aún habrá un exceso mayor en la ganancia en ácido cuando se trate el mineral de término medio del depósito.

Impurezas de la solución

De las impurezas que se van acumulando en la solución, los principales elementos, sin considerar el cloruro existente, son: ácido nítrico, alúmina, sales de fierro y alcalinas. Después de más de un año de trabajo con la misma solución, eliminando sólo la cantidad de solución suficiente para no tener un exceso de ácido, se encontraron las siguientes impurezas:

	Gramos por litros
Fe	3.71
Mn	0.07
As	nada
Sb	nada
Ca O	0.80
Mg O	3.32
$Al^2 O^3$	1.61
$Na^2 O$	21.60
$K^2 O$	5.09
Acido nítrico	4.09

Esta cantidad de impurezas es insignificante, en lo que concierne a la lixiviación y precipitación electrolítica. La impureza principal en la solución es el

cloruro obtenido de la parte superior del yacimiento. Al principio se creyó que sería provechoso electrolizar directamente la solución que contenía el cloruro, y se encontró que esto era fácil hacerlo en tanques electrolíticos cerrados, en los cuales se hacía un ligero vacío, de modo que todo el cloro producido se podía arrastrar por medio de aspiradores. Sin embargo, también se probó que por este medio sólo se extraía una parte del cloro, y que una parte apreciable se depositaba con el cobre cátodo, probablemente al estado de cloruro cuproso.

Se trataron varios métodos para precipitación del cloruro cuproso, y finalmente, como método más conveniente, se adoptó poner trocitos de cobre en un tambor. El cloruro cuproso formado sobre el cobre metálico, firmemente se adhiere a los trocitos de cobre, y así se encontró que era necesario presentar continuamente superficies de cobre limpio, a fin de obtener una buena precipitación. Después de ensayar varios métodos, se decidió que el mejor aparato para este objeto sería el tambor giratorio, semejante al molino de tubos, a través del cual pasa la solución, y se pone en contacto con el cobre un trocito contenido en el tambor; de esta manera el cobre, frotándose sobre sí mismo, continuamente presenta superficies limpias. También se trató de hacer la precipitación con ácido de cobre, y trabajaba muy bien, lo único que el cobre en esta forma era menos eficaz como precipitante que el cobre metálico, aun tomando en cuenta la diferencia teórica.

El cloruro cuproso obtenido puede tratarse de varias maneras diferentes. Se trata ahora de hacer pasar por filtros-prensas el cloruro cuproso depositado, y mezclar los cokes de las prensas con caliza y coke, fundiendo este producto para producir cobre metálico y una escoria formada por cloruro de calcio. A fin de establecer las reacciones que tienen lugar, se han efectuado un cierto número de experiencias, y se ha encontrado que se produce una escoria muy fluida y que contiene muy pequeña cantidad de cobre, y que de este modo perfectamente se puede llegar a fundir el cloruro cuproso sin tener pérdidas por volatilización. Igualmente, se han efectuado pequeñas experiencias sobre el tratamiento electrolítico del cloruro cuproso, y parece que después se aplicara este método.

Precipitación del cobre

La solución, libre ya de su contenido en cloruro, se electriza, usando ánodos insolubles y cátodos de cobre ordinario en hoyos. Después de larga experimentación, se decidió emplear un ánodo insoluble, hecho de magnesita. Se ensayaron también varios otros cuadros, con más o menos buenos resultados, pero después de haber investigado todas las posibilidades, se decidió por los ánodos de magnesita. Las experiencias con estos ánodos duraron más de año y medio, y no se notó desgaste químico apreciable en los ánodos. Los ánodos de magnesita adoptados los fabrica por un procedimiento secreto, la Chemische Fabrik Griesheim Elecktron, de Frankfort, Alemania. Por la naturaleza misma del material que forma el ánodo, éste es quebradizo. Sin embargo, como no será necesario mover el ánodo después de instalado en los tanques, no constituye esto un gran inconveniente.

Al principio se encontraron dificultades al tratar de tener una distribución uniforme de la corriente, y una suspensión apropiada para los ánodos, pero se subsanaron todos estos inconvenientes, y se cree que se ha llegado a conseguir un ánodo que prestará muy buenos servicios. Los ánodos se les funde huecos, y el espesor de las paredes es aproximadamente de un cuarto de pulgada, e interiormente están cubiertos por una capa delgada de cobre, depositado electrolíticamente. Como no conozco en sus detalles el modo de fabricar estos ánodos, me es imposible dar sobre ellos más detalles; solamente puedo asegurar que después de meses de trabajo continuado, se ha encontrado que los ánodos son perfectamente satisfactorios para el objeto a que se les ha destinado.

Los cátodos de cobre producidos por la electrolisis son de la calidad corriente de cátodos de cobre, pero sí un poco mejores, porque en este caso particular no hay ni arsénico ni antimonio (que son los elementos más perjudiciales que se presentan en los cátodos de cobre), en la solución. La solución entrará en el primer estanque del sistema electrolítico con un contenido de 5 por ciento de cobre y 2½ a 3 por ciento de ácido libre, y saldrá de la última tina de la cascada conteniendo 1.5 por ciento de cobre y 8 a 9 por ciento de ácido libre. Dentro de estos límites siempre es posible producir un cátodo bueno y duro, igual o mejor que el Standard corriente. Los estanques electrolíticos usados en las experiencias, se construyeron de concreto revestido de asfalto.

Planta que actualmente se construye en Chuquicamata

A causa de lo enorme del yacimiento reconocido en Chuquicamata, la primera necesidad de la planta que actualmente se construye, se ha proyectado para tratar 10,000 toneladas de mineral por día. La refinería electrolítica tendrá capacidad para 335,000 libras de cobre diarias.

El mineral se explotará por medio de palas a vapor, pues prácticamente no se necesita hacer ninguna limpia del estéril. El mineral se transportará al establecimiento, que dista 2½ millas de la mina, por medio de ferrocarril americano de carga, en que los carros tienen capacidad de 60 toneladas, cada uno.

A la llegada al establecimiento, el mineral pasará primero por chancadoras giratorias, después por discos triturado-res Symons de 48 pulgadas, y finalmente por cilindros Garfield, hasta obtener un producto que pase por un tamiz de un cuarto de pulgada. El mineral se transportará en correas sin fin, después de molido, a los tanques de lixiviación. Cada uno de estos tanques tiene de ancho 110 pies, de largo 160 pies y 16 de alto. Las tinas de lixiviación, en número de seis, se colocarán una a continuación de la otra. La correa que trae el mineral de la planta de molienda se descargará en las tinas de lixiviación, con la ayuda de un puente eléctrico móvible que puede recorrer todo el largo de las tinas. Los residuos tratados y lavados se sacaron de las tinas por medio de un sistema de capachos de 15 toneladas, que funcionará sobre un puente, y después de nutridos, se vaciarán a una correa de descarga, para depositarlos en el desmonte. Los estanques se están construyendo de concreto macizo y reforzado, y se recubrirán con una capa de mástico de asfalto de 1½ pulgada de espesor. Este revestimiento de las tinas lo ha preparado la Vulcanite Paving Co., de Filadelfia, y consiste de una mezcla de asfalto Trinidad refinado, al cual se le ha agregado cuarzo o granito molido.

En la planta de experimentación, donde este mástico se ha usado por más de un año, tanto en las tinas de lixiviación como en las de electrolíticas, nunca se tuvo la menor dificultad ni la menor filtración.

El material se ha probado a la temperatura de 50° C, sin haber encontrado ningún signo de ablandamiento, y como esta temperatura es muy superior a la con que se piensa trabajar, no se han efectuado pruebas a temperaturas más altas; sin embargo, el límite de temperatura a que principia a ablandarse el material, está probablemente comprendido entre 50 y 70° C. Pruebas también se han hecho para probar la resistencia de este material, bajo el punto de vista físico, y en una ocasión se colocó un cátodo de 250 libras a cinco pies del fondo del estanque, y después se bajó, de modo que un extremo de este cátodo calentase el recubrimiento de asfalto del fondo. En este caso se destruyó un pedazo del revestimiento, en un espesor de un cuarto de pulgada y en dos pies de diámetro, y en lo que se pudo ver del revestimiento de mástico, estaba tan bueno como al principio. El material se ha probado con soluciones de ácido concentrados y débiles, y se ha mostrado inatacable.

La solución se sacará por el fondo de los estanques, haciéndola pasar por ocho aberturas, de 6 pulgadas cada una y bien distribuidas en cada tanque. Se empleará un falso fondo, que consistirá en dos enrejados de madera, entre los cuales se colocará un tejido de cocoa. Este filtro se encontrará a cuatro pulgadas sobre el fondo del tanque. Para el circuito principal de circulación se usarán dos cañerías de fierro, revestidas con plomo, una de 9 y la otra de 16

pulgadas de diámetro. Para la circulación del líquido se usarán bombas centrífugas horizontales, construídas de metal tipo. Las bombas tendrán una capacidad de 550 pies cúbicos por minuto, y podrán elevar hasta 60 pies. En la planta de lixiviación, el ciclo de operaciones necesita aproximadamente seis días, de los cuales uno se ocupará en cargar las tinas, dos en la lixiviación, dos en el lavado y drenaje, y uno en la descarga.

La solución se conducirá a las tinas de lixiviación sólo por gravedad, pues se dispondrán tanques de captación a un nivel superior que las tinas de lixiviación. Las dimensiones de estos tanques para soluciones serán las siguientes:

Dos tanques de 12×130×150 pies
Siete tanques de 12×70×150 pies

De los tanques de solución concentrada, la solución pasará por la acción de gravedad a la planta de descloruración, que consistirá en veintiún tambores giratorios de 30 pies de largo y 4 de diámetro, construidos de acero y revestidos con material terroso. Estos tambores estarán hasta la mitad llenos de cobre en trozos. De estos tambores, la soulción que tendrá el cloruro cuproso en suspensión pasará a siete desenlodadores Dorr, hechos de concreto y revestidos con mástico de asfalto. La solución clara que se rebalsa pasará por gravedad a la refinería electrolítica, en tanto que el cloruro cuproso con 1 por ciento más o menos de la solución, pasará a los filtros prensas.

La refinería electrolítica consistirá de 510 tinas, con las siguientes dimensiones: 19 pies de largo, 3½ pies de ancho y 4 pies 10 pulgadas de profundidad. Se construirán de concreto, revestidas con mástico de asfalto y se colocarán enterradas, pero se dispondrán galerías de inspección y una plataforma de concreto entre las corridas de tinas. El edificio para las tinas se construirá con concreto y acero. De las 510 tinas, 30 se usarán para hacer cátodos en hojas para iniciar la operación, y las 480 restantes se emplearán para la precipitación electrolítica del cobre contenido en la solución. Las tinas se dispondrán en cinco circuitos eléctricos, con 96 tinas por circuito, y se dividirán en 30 circuitos para solución; la solución en cada circuito pasará por 16 tinas, dispuestas en cascada.

Los ánodos fabricados de magnesitos serán de 5 pies de ancho, 2 pulgadas de grueso y 4 pulgadas de largo, y se colocarán de a 5 en una barra. Los cátodos serán de 3 pies de ancho por 4 pies de profundidad. El electrólito sobrante, que contendrá 1,5 por ciento de cobre, se bombeará a los tanques de acumulación, para usarlo con las nuevas y subsiguientes cargas de mineral. El cloruro cuproso obtenido en la planta descloruradora se fundirá, y con él se harán trocitos de cobre para usarlos en los tambores descloruradores.

Metalurgia del Plomo.

En el año de 1913 se han estudiado detalles de aplicación o prácticos. De trabajos de laboratorio han aparecido entre otros, el de Kohlmeyer, en Metall and Erz, X, 483, sobre el sistema PbO—Fe_2O_4, llegando a las conclusiones siguientes:

I. Será a propósito la espinela magnesiana para crisoles y hornos, por resistir el fuego y ser impermeable a vapores y gases de Pb O.

II. El platino para temperaturas elevadas es algo soluble en PbO, menos en ferrito de plomo, y aún menos en el ferrito ferroso.

III. El óxido férrico se transforma entre 920 y 950° C. en la modificación negra; se aglomera a 1,370°; empieza a fundirse a 1,470°, y después de descompuesto, se funde completamente entre 1,525 y 1,600°, punto probable de fusión del $Fe_3 O_4$. Existen otros ferritos de hierro con mayores contenidos de $Fe_2 O_3$. El ferrito ferroso magnético pulverizado se oxida a 500° y pasa al no magnético férrito; desde 450° pierde en impermeabilidad, y no son magnéticos a más de 350°.

IV. La proporción de fusibilidad de las mezclas de PbO—$Fe_2 O_3$ se fijará en diagrama.

V. Es posible la existencia de combinaciones 3 PbO—$Fe_2 O_3$, (3 FbO—2 Fe_2O_3, PbO—Fe_2O_3. 2 PbO—3$Fe_2 O_3$,—PbO—2 Fe_2O_3.

VI. 62 por 100 de peso de $Fe_2 O_3$ rebajan el punto de fusión del óxido de plomo desde 885 a 752°.

VII. La volatibilidad relativa del óxido de plomo y la descomposición de los óxidos de hierro en estas mezclas se determinarán por la mayor temperatura.

VIII. Las propiedades del ferrito de plomo y del ferroso se definirán por la manera de conducirse con los ácidos el H-O y SO_2 y por el peso específico.

En la misma revista ha publicado von O. Proske sus estudios sobre descomposición del sulfato por el óxido de plomo, y llega a:

I. El óxido férrico y la sílice favorecen en pequeño la descomposición del sulfato.

II. Por bajo de 900° C., temperatura de formación del ferrito de plomo, no existirá descomposición, o será pequeñísima.

III. El óxido ferroso a temperaturas inferiores a 800° C. se transformará por el O del aire en férrico, a altas temperaturas descompondrá el sulfato de plomo por cederle oxígeno.

IV. Las propiedades físicas del óxido de hierro en la descomposición del sulfato intervienen obrando a 1,200° más enérgicamente que el óxido rojo.

V. Lo mismo se verifica en la cuestión industrial de las galenas.

El ingeniero Wilhelm Menzot, en otro cuaderno de Metall and Erz, estudia el tratamiento de las matas copruplumbíferas, y llega a las conclusiones:

I. Por fusión con sulfato sódico no hay separación de cabezas y fondos, o sea matas con casi todo el cobre y otras con todo el plomo.

II. El sulfuro de plomo se descompondrá con la cal formando sulfuro cálcico y plomo metálico.

III. El grado de descomposición podrá llegar al 70 por 100; el resto del sulfuro de plomo formará con el de calcio soluciones homogéneas o combinaciones, y será extraído por desulfuración posterior.

IV. Por fusión precipitante con hierro, no puede aumentarse prácticamente la acción añadiendo cal, sino que se disminuye.

V. El sulfato cálcico perjudica en el procedimiento de precipitación y el de bario es menos perjudicial.

VI. El sulfato y mata de cobre son descompuestos por cal y carbón, dando cobre.

VII. En la utilización de la cal como desulfurante pueden usarse hornos de reverbero eléctricos.

VIII. Para la fusión eléctrica de mata copruplumbífera se utilizará sólo el horno de resistencia, evitando el de arco por la gran volatilización del plomo.

Electrometalurgia de los minerales de plomo

En cuanto a la obtención del plomo de sus menas, mediante el calor desarrollado por la corriente eléctrica, mencionaremos los proyectos de Francis Louvrier y C. Luis, el último conocido en España, por haber montado un horno eléctrico en una fábrica de hierro del Norte.

Louvrier supone que un caballo-año eléctrico equivale a 2,700 kilos de coke quemado en hornos no eléctricos, y concluye de la comparación de los dos agentes técnicos, bajo ciertas condiciones, ser de dos a cinco veces más baratos los hornos eléctricos que los de coke, con las siguientes ventajas del primero:

Regularización mejor de la temperatura por manejo de los electrodos o por interruptores; constante producción del calor necesario; eliminación del calor necesitado; eliminación del efecto enfriante de las escorias; tratamiento fácil de toda mena; mayor producto, por no necesitar el horno eléctrico oxígeno o aire para funcionar, produciendo menos escorias y más fluidas; menos trabajo manual por menor cantidad a tratar o por no necesitar triturar la mena o no aglomerarla; supresión de aparatos soplantes; menos reparaciones, por producirse el calor en el centro de la carga y no en las paredes del horno; tener metales más puros; posibilidad de tratar los minerales en las minas y

disminución de los gastos de transporte.

Dice que en los hornos de zinc, un caballo-año eléctrico equivale a 7,000 kilos de carbón, obteniendo el 95 por 100 del contenido en la mena; en los de estaño a 3,600, dando mayor producto por no oxidarse ni evaporarse; en los crisoles para hacer acero es igual a 18 toneladas; y como la producción de tal energía en máquinas de gas se necesitan 3,855 kilos, en tales industrias puede substituirlas.

Los autores citados proyectan el horno eléctrico para todos los metales con las ventajas para los ahora usados, de poder ser de carga, cosa no frecuente, regulan bien la temperatura; pues los electrodos no son grandes, ni tienen que sufrir el roce de las substancias.

Es de cuba y se compone de tres partes: la cuba para calentar progresicamente las menas; los etalajes o zona de reducción y el depósito o crisol, compuesto de material muy refractario y no conductor, siendo el fondo conductor, y unido con una de las fases de la corriente. En los etalajes, tiene aberturas a distintas alturas, colocadas en dos series, enfrente una de otra, en paredes opuestas, que dan paso a los electrodos, correspondiendo cada serie a una fase de la corriente; los huecos entre los electrodos y las aberturas se impermeabilizarán con lodo. Se cierra el horno de modo apropiado con toma de gases, aunque el óxido de carbones se quema en la cuba por aire que entra por las aberturas.

Los electrodos colocados horizontalmente se desgastan por combustión; de vez en cuando se empujarán dentro, pasando la corriente de unos a otros y al fondo, de manera que la carga servirá de resistencia, obteniendo temperatura prácticamente constante.

Si se quisiera emplear para reducir cobre, se uniría al reposador para refinarle con toberas; en otro caso lleva bigote y canillero.

Las ventajas de este horno, según los inventores, son: sencillez de construcción y de regular la temperatura; posibilidad de usar altos voltajes, 120 voltios en los pequeños, 240 en los medios y 350 y 400 en los grandes, que pueden ser enormes, cerrados completamente; gasto pequeño de electrodos, por no estar rodeados de aire ni de gases; poco trabajo manual por lo capaces y poca radiación; el calor arrastrado por los gases se emplea en calentar la carga, y si son combustibles se queman dentro; es continuo con zona grande de reducción.

Condensación de humos

Actualmente, en todos los tratamientos metalúrgicos se considera beneficioso condensar los humos y recoger sus elementos valiosos para nuevo tratamiento. Los principales procedimientos son los de galerías o cámaras, que llevan placas, o mejor redondos, de hierro, ya horizontales, ya verticales, 10 sacos los electrostáticos; el llamado del tiógeno; el de fabricación de ácido sulfúrico y los mixtos.

Los de galerías o cámaras son redondos, de hierro, y con sacos son los predominantes, o, por mejor decir, los de más reputación; los otros están en período de pruebas, habiendo algunos con resultado satisfactorio, como el electrostático de Conttrel, aunque la instalación de Balaklaba no los diera completos, se explica, por no tener en cuenta que los gases no conducirán mucho polvo en unidad de volumen, que deberan estar algo húmedos y que su velocidad no sea demasiada.

En el del llamado tiógeno, se hizo primero el modelo de ensaye, y se ha aplicado en 1313 a una fábrica de América del Norte; esperando algunas pequeñas modificaciones para obtener azufre amarillo y no gris, pues los gases sulfurosos se destruyen casi por completo, dejando aprovechable este elemento.

Se reciben los humos y gases de los hornos, con bastante ácido sulfuroso, y se reunen con vapor inyectado pasando reunidos a la galería de contacto de unos m. 12.20×2.13, con 9.41.83 alto, en donde se le mezcla una cantidad de aceite mineral vaporizado, y todo ello atraviesa 9 diafragmas de contacto, formadas por ladrillos de yeso, mezclado con serrín y calentado en fuego reductor, que hace se convierta el sulfato en sulfuro; en él se ven los huecos para el paso de los vapores. En la cámara de condensación se enfría por el agua inyectada, recogiéndose en tolvas de fondo pasan a la otra cámara y galería, en donde un ventilador los lanza a la chimenea.

Otro aparato para aprovechar el azufre del anhidrido sulfuroso procedente de la tostion de piritas, y al mismo tiempo, entrega la substancia aglomerada, ha patentado y registrado Hall, aplicación de convertidor Dwight Lloid, es un horno con rejilla sin fin, a que la tolva A. llena de la substancia a tostar; la rejilla lo lleva primero cubierta por una cámara, en donde existe el mechero, procurando sea la atmósfera reductora, y al salir de ella, puede ser puesta en contacto la substancia con el vapor de agua.

Por bajo de la cámara de combustión está la de sección, con su tubo en comunicación con el ventilador. Según el autor, por lavado se tiene el azufre, y la substancia tostada y en pedazos.

No hacemos mención, como se ve, de los aparatos usados en los hornos altos, bien sean con agua o sin ella.

Al tener que alisar de nuevo alguna válvula, sería conveniente poner debajo de su cabeza un pequeño resorte, para que levante la válvula de su asiento; luego habrá que manipularla de arriba a abajo, a fin de que la substancia raspante entre en el asiento. Al hacer el trabajo la válvula, debe moverse con un movimiento recíproco, y no en una sola dirección, porque de este modo se formarían lomos.

Micro-Química.

El análisis cualitativo micro-químico, dispone de métodos seguros, elegantes, rápidos; no hay obra de análisis químico que no los señale. Sin embargo, es poco empleado en la industria; los laboratorios científicos son casi los únicos familiares con sus reacciones.

Es que la industria en general, se ocupa poco de análisis puramente cualitativos; se limita rara vez a preguntar si tal cuerpo existe en un mineral, un metal, una aleación, pero exige dosajes. Sin embargo, la micro-química puede dentro de sus dominios, rendir servicios, dando una aproximación de los contenidos. A menudo esta aproximación bastará para deducir la conclusión; otras veces autorizará a renunciar a un examen más preciso de tales o cuales muestras. Es así como en las investigaciones de minas, se podrá hacer dos lotes de muestras recogidas por un sondaje; uno de ley netamente insuficiente de la substancia útil o de ley prohibitiva de las materias perjudiciales, y otro que merecer; un análisis cuantitativo exacto.

En metalurgia, basta a menudo clasificar las aleaciones según las leyes de tal o cual constituyente, sin tener en cuenta el valor absoluto de estas leyes, etc.

Es en un caso semejante que conviene estudiar la aplicación de la micro-química, no en verdad a la dosimasia, sino a la clasificación de muestras. Así, se trataba de estudiar en algunos meses, tres yacimientos de bauxita roja, destinada a la fabricación del aluminio. Esta bauxita formaba bolas que tenían hasta algunas docenas de metros de diámetro, encerradas en tierras rojas constituídas por silicatos de alúmina, óxido de fierro y más o menos hidrato de alúmina. La bauxita, para ser utilizable en la fabricación de alúmina, no debía contener más de 3 por ciento de sílice. Entre las tierras rojas, francamente silicatadas y la bauxita de 3 por ciento de sílice, existían todos los términos de transición que, a menos de 15 por ciento de sílice, no se distinguían al ojo, de la bauxita comercial. Tres equipos de sondeadores suministraban hasta veinte muestras por día; era de toda necesidad poder analizar sólo los productos buenos que debían servir de base a la valuación de los yacimientos; es decir, de débil contenido de sílice.

Se ensayó primeramente por la observación con la lente con muestras convenientemente pulidas, y después por la acción de reactivos (ácido fluorhídrico, verde malaquita, etc.); luego por el examen al microscopio polarizante, de láminas delgadas. El primer método no ponía en obra sino un medio organoléptico, y era tan insuficiente como el exa-

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* Traducido de La Technique Moderne.

men al ojo desnudo. El estudio de las láminas delgadas de un compuesto casi coloidal, no podía tampoco ser muy concluyente.

En fin, estos dos procedimientos tenían el grave inconveniente de no someter a la apreciación, sino una parte muy mínima de la muestra. La microquímica suministra la solución.

El examen micro-químico, se hace en general, con un microscopio polarizante simplificado. La lente "Bertrand," y el condensador para el examen en luz convergente, no son de utilidad alguna; los Nicols, la platina giratoria, el retículo, son a veces útiles para la determinación de ciertos cristales. La ampliación no necesita sobrepasar de 200 diámetros; para apreciar la intensidad de una reacción, es bueno poder examinar el conjunto de la gota de líquido colocada sobre el porta-objeto. Una ampliación de 50 diámetros permite tener por entero, en el campo, una gota de 2 a 3 mm.

Pero lo esencial en cambio es, que la distancia entre el objetivo y el objeto sea la mayor posible; se orienta así fácilmente la preparación, las manipulaciones son más cómodas y rápidas, y, en fin, no se arriesga de poner en contacto los reactivos y las lentes inferiores; luego se usará débiles objetivos y fuertes oculares. Un instrumento semejante cuesta unos 200 francos. Es casi indispensable adaptar a este microscopio, una cámara clara que permitirá conservar por un croquis, un recuerdo exacto de las precipitaciones, sobre todo, de su intensidad.

Será bueno recubrir las gotas de líquido que se va a ensayar, de un protector que retardará la evaporación; sera muy simplemente constituido por un porta-objeto corriente, cuyos ángulos serán doblados al fuego de la lámpara. Se disolverá el producto que se va a examinar y no se tendrá, en general, que hacer separaciones; las precipitaciones simultáneas no molestan, cuando es fácil identificar unas de otras. Una gota del licor se coloca sobre el porta-objeto. Se ha encontrado conveniente hacer el examen sobre gotas poco voluminosas, pero regulares de forma y de peso, más bien que sobre toques muy mínimos, cuya concentración varía muy sensiblemente por la adición del reactivo sólido agregado. En una gota irregular, el precipitado se reune en algunos puntos y es incómodo apreciarlo cuantitativamente.

Para depositar estas gotas que no deben sobrepasar de mucho, el campo del instrumento, los cuenta-gotas del comercio, no podrían convenir: es preciso servirse de un tubo estirado, capilar y mantenido bien verticalmente. Es evidente que el ensayo se lleva a cabo sobre varias gotas.

Es indispensable, primeramente, hacer un gran número de ensayos previos, partiendo de licores que no contienen en primer lugar, sino el cuerpo buscado, y en seguida, este cuerpo y los que le acompañan generalmente en el producto que se va a examinar; se hará variar las concentraciones y se dibujará en la cámara clara, algunas precipitaciones que servirán de ferencias.

Será bueno recomenzar este trabajo de tiempo en tiempo. En el examen de las bauxistas, el ataque se hizo con carbonato sódico-potásico; el licor contenía silicatos y aluminatos alcalinos.

En realidad, lo insoluble contenía, además del óxido de fierro y el subtitanato alcalino, un poco de sílico-aluminato; pero la cantidad de sílice así retenida, era tan débil, que el error no podía cambiar en nada la conclusión del ensaye por sílice.

El licor adicionado de molibdato de amoniaco y de un exceso de ácido nítrico, calentado, era diluido en un volumen constante; algunas gotas eran depositadas sobre el porta-objeto, y, con el auxilio de un hilo de platino muy fino, cada una de ellas recibía un pequeño cristal de cloruro de rubidium. El sílico-molibdato de rubidium, formaba un precipitado de pequeños cristales amarillo-pálido, que parecían esféricos a débil ampliación. Se ha podido observar que los silicatos puros daban, a igualdad de concentración, un precipitado más abundante que las mezclas de silicatos y de aluminatos. También las operaciones de taraje eran hechas primeramente, partiendo de un silicato y de un aluminato (20 de alúmina por 1 de sílice), más tarde partiendo de la bauxita.

Planificación de los Distritos Mineros.

(Continuación).

Cuarto Caso.—Condiciones a que los Planos Interiores Deben Satisfacer, para los Fines Generales de la Industria.

El interés del investigador de una región minera, en lo tocante a detalles de las explotaciones existentes en esa región, puede concretarse a lo siguiente:

1o. Cerciorarse de la continuación a rumbo de las vetas y de sus cambios de dirección y echado.

2o. Documentarse acerca de la mineralización, en general, de los criaderos reconocidos y de los camios de dicha mineralización, a profundidad.

3o. Adquirir datos acerca de la formación geológica y escialmente de la influencia que los cambios en dicha formación ejerzan sobre la riqueza mineral.

Pero no sólo los investigadores o las empresas nuevas están interesados en conocer los datos interiores. Entra también en los intereses generales de la industria el conocerlos, puesto que de ellos depende, si son examinados e interpretados completamente, el que los trabajos nuevos se apoyen en una base científica y no signifiquen desembolsos inútiles ni den lugar a especulaciones de mala fe, de las que la industria no deriva beneficio ninguno.

A las empresas ya establecidas, el conocimiento de los datos que se han citado les servirá para ampliar su esfera de acción si les conviniere, mas si no encontraren interés en hacerlo, ningún menoscabo sufrirán si otras empresas, utilizando los datos existentes, investigan zonas nuevas y llegan a encontrar riquezas desconocidas que contribuirán al progreso general de la localidad y al bienestar de la sociedad. No hay que olvidar la opinión general entre los hombres peritos del gremio: que la riqueza minera debe ser explotada activamente, de modo que los productos se obtengan en el mínimum de tiempo; y que las riquezas del subsuelo sólo adquieren valor cuando son extraídas, transformadas y lanzadas a la circulación comercial.

Los ingenieros que han tenido que proyectar trabajos en regiones nuevas o informar acerca de aquellas que por largos años han estado paralizadas, saben muy bien cuántas dificultades les hubiera ahorrado la existencia de un trabajo de planificación que su pliría con notoria ventaja a los escritos muy diseminados y a veces incoherentes, que es necesario consultar.

Así, pues, conviene que en los planos generales de los distritos se consigne la traza de todas las vetas, deducida de los levantamientos a distintas profundidades, sobre un plano general de referencia, pues el hacerlo, como ahora se acostumbra, fijando puntos de los crestones, da lugar a interpretaciones falsas, cuando no se tiene en cuenta, como a menudo sucede, los desniveles del terreno y no permite localizar aquellas vetas que no crestonean.

Existen minerales, como El Oro y Tlalpujahua, en los que hay vetas que no crestonean y es en esos centros mineros donde se ha evidenciado lo innecesario y aun nocivo de esa reserva, que no vacilo en calificar de tonta y egoísta, que como resto de las viejas rutinas, ha persistido entre nuestros mineros. Las principales compañías que en los Minerales a que me ne referido trabajan, publican sus planos con toda suerte de detalles y, sin embargo, ningún perjuicio han resentido con esa publicidad.

Hay, en cambio, en otros Minerales, empresas que no han obrado de la misma manera y éstas son las que han dado lugar a la ejecución de obras costosas, trazadas a la ventura y que podrían haberse modificado o evitado, contando con datos positivos, siquiera acerca del rumbo y echado de las vetas.

La inversión de capitales para la explotación de minas, si bien tien un margen de eventualidad mayor que el de otras industrias, y en relación con los cuantiosos productos que las minas rinden, no debe destinarse a promover movimientos de Bolsa, con el aliciente, más o menos fundado, de cortar la continuación de vetas famosas; pues la industria

minera y el juego de Bolsa, están del todo divorciados y aun se puede decir, que en la forma que generalmente se da al segundo, siguen caminos diametralmente opuestos. El minero debe buscar el descubrimiento de riquezas subterráneas, PARA EXPLOTARLAS; siendo así como contribuye al bienestar social, para lo cual debe aprovechar, como fundamento para sus arriesgadas empresas, cuantos datos positivos estén a su alcance.

Otro dato de importancia para los intereses generales de la minería, es el relativo a la distribución de la mineralización, a rumbo y a profundidad, estudio de capital importancia, que no se ha hecho en México, ni siquiera en los más importantes y antiguos Minerales, salvo observaciones aisladas de algunos inteligentes y laboriosos ingenieros.

Sin duda que al dilucidar este punto integralmente requiere largos y concienzudos estudios. Quizá sea la magnitud misma de la labor lo que ha hecho aplazar indefinidamente su ejecución; pero no cabe duda que si las empresas mineras y los ingenieros de minas que en ellas intervienen, se propusieran coordinar sus observaciones, pronto se constituiría un estudio, aunque fuera preliminar, sobre asunto tan importante, mientras no exista en México una institución especial que consagre su actividad a la resolución de tales problemas (1).

(1) En la obra "La Industria Minera en México," que con la cooperación de los más distinguidos ingenieros residentes en el país, y bajo el patronato de poderosas empresas y de inteligentes mineros, así como con la ayuda de la Secretaría de Fomento, estoy publicando, se ha procurado hacer esa recopilación preliminar hasta donde los elementos disponibles lo han permitido y en una escala desconocida hasta hoy en México.

Aún más ignorado se encuentra lo tocante a la geología de los distritos mique existan entre las formaciones geológicas y las variaciones en la mineralización. Este es un punto que un país minero como México debería tener al día; siendo de notarse que acerca de él hay también muchos datos dispersos, sobre todo en publicaciones extranjeras y en los archivos particulares de algunos ingenieros de minas. Falta solamente un cuerpo pericial, debidamente autorizado, que coordine tan rico material y lo ponga en conocimiento de los ingenieros de minas, teniéndolo al día, con las explicaciones técnicas necesarias, emitidas bajo la responsabilidad de la institución que tomara a su cargo tan importante y meritoria labor.

Si en los planos de conjunto de los distritos mineros se consignara la formación geológica, aunque fuera a grandes rasgos se tendría con eso un preliminar importante para la obra definitiva. Esta ventaja, que desde hace tantos años se ha ponderado, no se ha empezado a aceptar por las compañías mineras sino hasta muy recientemente, habiendo sido la Compañía de Real del Monte y Pachuca la primera que, hace cuatro años próximamente, ha tenido un geólogo de planta efectuando esos estudios fundamentales. La Compañía de "Las Dos Estrellas," de Tlalpujahua, estableció también una plaza de geólogo a principios de este año de 1912.

Los hechos han demostrado la importancia que tales estudios tienen, pero si se limitan a ejecutarse en provecho de las grandes compañías y para su uso exclusivo, la tarea pierde gran parte de su importancia, pues es justamente en favor de las empresas nuevas y como preliminar indispensable de las explotaciones, como tales trabajos tendrán mejor aplicación.

Las variaciones que el cambio en la clase y aun en la textura de las rocas producen en los yacimientos minerales, así como la clasificación de esos yacimientos y el efecto que sobre ellos ejerzan las fallas o diques, son puntos acerca de los cuales existe un cuerpo de conocimientos positivos que los geólogos pueden definir en cada localidad, y que deben estar al alcance del ingeniero consultor que visita una mina y que a veces pretende hacer estudios geológicos en unos cuantos días, incurriendo en los más groseros errores.

La Dinamita.

La fuerza de la dinamita depende de la cantidad de nitroglicerina absorbida por unidad de peso determinada. Por ejemplo, si un cartucho, de una libra de peso, contiene 60 por ciento de nitroglicerina y 40 por ciento de tierra se la llamará "dinamita de sesenta por ciento."

Posteriormente se halló que la dinamita podía hacerse más eficaz y más barata empleando como material absorbente madera en polvo o harina de madera y mezclando la nitroglicerina con otras sustancias tales como amonia y nitrato.

La dinamita moderna se fabrica de varias calidades. La hecha de nitroglicerina y polvo de madera es considerada como la dinamita auténtica. Tratándose de esta clase, una dinamita de cuarenta por ciento lleva el 40 por ciento del mismo poder explosivo que tiene una cantidad de nitroglicerina líquida de igual peso; así mismo, un cartucho de dinamita hecha con polvo de madera, nitroglicerina, nitrato de amonia y otras sustancias químicas que se le agregan para hacerla de baja congelación, tendrá un 40 por ciento comparado con la nitroglicerina líquida, pero no contiene por supuesto, un 40 por ciento de nitroglicerina ya que gran parte de su fuerza se la dan otros ingredientes.

La más usada en los trabajos de ferrocarriles y cantería es la dinamita de 40 por ciento, de baja congelación, la cual contiene nitroglicerina mezclada con otras sustancias. La misma clase se usa para la voladura de peñascos y troncos de difícil remoción, pero para los trabajos ordinarios de agricultura la dinamita extra de 20 por ciento, de baja congelación, es suficiente y más barata que la de gran poder. Tal dinamita no contiene 20 por ciento de nitroglicerina puesto que la mayor parte de su fuerza se la dan el nitrato de amonia y otros componentes.

La dinamita de nitroglicerina pura no es necesaria en ninguna tarea de agricultura si se hace excepción de los trabajos—muy extendidos hoy— de apertura de zanjas para los cuales se requiere dinamita muy sensible al choque. Se puede emplear también dinamita extra de 20 por ciento para esta clase de trabajo si se dispone de una máquina para determinar la explosión de la carga. Esta misma dinamita, con mecha y fulminante encendido, es muy usada para la remoción de subsuelos y para la plantación de árboles, y lo será también para la voladura de troncos tan pronto como los hacendados estudien la manera de hacer tal trabajo económicamente Las grandes compañías poseedoras de extensos terrenos, que compran la dinamita por furgones han hallado que la remoción de los troncos de pino puede hacerse satisfactoriamente con dinamita de 20 por ciento, de baja congelación. El hacendado que sólo labora unos pocos acres de tierra podría también hacer lo mismo con igual éxito.

El Carbón Vegetal.

El carbón vegetal, en sus distintas fases, ejecuta importantes funciones en la economía doméstica e industrial, pero a pesar de lo dicho, no todo el mundo conoce sus verdaderas características. En épocas anteriores, su servicio más útil fué reducir el mineral de hierro al estado de hierro crudo. En las forjas de los antiguos metalurgistas se servían del carbón vegetal para convertir directamente en acero aquellos minerales ricos en hierro; aquello que se ha conocido como procedimiento de Wootz, lo efectuaban de esta manera.

Hubo un tiempo en que la fundición al carbón vegetal se extendió muchísimo en Escocia, y fué lo que dió origen a aquellas grandes fábricas de hierro y de acero que no tardaron en contribuir a la fama del país. El empobrecimiento de las florestas ha restringido excesivamente la manufactura de hierro al carbón vegetal, al extremo que hoy día no hay sino un horno funcionando, y es el de Backbarrow, a orillas del río Leven. Este horno fué construído a principios del siglo XVIII, y desde entonces ha cambiado muy poco. Su producto de hierro es el más caro que existe, y su mayor parte tiene consumo en los Estados Unidos, para la fabricación de piezas de hierro maleable.

El carbón es el resultado de la destilación destructiva de la materia ani-

nal y vegetal. La composición depende mucho de la temperatura a la cual se produce. A altas temperaturas desaparecen el oxígeno e hidrógeno de las materias, dejando como residuo una substancia negra. Arde sin llama o humo y produce un calor intenso. Infusible, no es soluble en los ácidos u otros líquidos, no está propenso a descomponerse, y ningún grado de calor lo cambiará, a menos que no se halle expuesto a una corriente de oxígeno. El carbón posee muchas otras ventajas.

ACCION DE LA SAL SOBRE LA MADERA

Hace poco tiempo, al reemplazar el andamiaje de madera instalado en la orilla Norte del Lago de la Sal—Estados Unidos—y cuyo objeto es el de sostener un tramo de vía férrea, se halló que los estacones de apoyo colocados dentro del agua y que habían prestado servicio por cerca de cuarenta y tres años consecutivos, estaban perfectamente sanos. Pudo verse, al examinarlos, que tales estacones—hechos de pino y abeto—se encontraban impregnados de sal, substancia en que abundan las aguas de aquel lago.

Tal hecho determinó el que el United States Forest Service emprendiera las investigaciones que de la acción preservativa que la sal ejerce sobre la madera. En otro punto del mismo lago, se halló que varios estacones de 18 pulgadas, colocados allí, se encontraban en igual buena condición, debido a la sal, que había penetrado hasta el propio centro de ellos. La estructura de madera que atraviesa aquel lago, y sobre la cual van los rieles del ferrocarril Southern Pacific, fué instalada en el año de 1902, y actualmente se encuentra en la misma buena condición del día en que se le colocara. En este caso, el salpique de la sal ha preservado la parte de la estructura que sobresale del agua. La primera línea telegráfica transcontinental, tendida antes de que las vías férreas se instalaran, arrancaba de Salt Lake City y se extendía a través de los entonces prósperos campos mineros de Eureka, Austin y Virginia City. Cuando se construyó el primer ferrocarril, aquella línea telegráfica fué transladada al lado derecho de la vía, y los postes antiguos se aserraron a nivel del suelo. Un examen recientemente practicado, ha puesto en evidencia que las partes de ellos dejadas dentro de la tierra, en la región salitrosa cercana a Fish Springs, Utah, están hoy, después de cincuenta años, en completo buen estado. En el valle de Salt Lake se practica desde hace mucho la costumbre de preservar la extremidad de los postes clavada en el suelo, enterrando en torno de ella una cierta cantidad de sal, que generalmente asciende a setenta y cinco libras.

CUIDADOS QUE REQUIEREN LAS BATERIAS

Una batería no alcanzará su máximum de eficiencia mientras el electrólito no cubra la parte superior de las placas que van en los acumuladores. Cada dos semanas deben examinarse las baterías, y si se halla que el electrólito está bajo, agregarle agua destilada en cantidad suficiente. Nunca se ponga ésta en exceso, porque entonces rebasa y determina la corrosión de las extremidades, lo cual es también causa de que la batería pierda en eficiencia.

Antes de poner en uso una batería, examínesela cuidadosamente y agréguesele agua si así fuere necesario. Cuando ha estado durante un tiempo sin prestar servicio, lo más prudente es cargarla de nuevo antes de que se la vuelva a utilizar. Téngase siempre el cuidado de que no haya corrosión en las extremidades, y de que los alambres estén debidamente conectados.

La corrosión, que es un depósito verduzco, puede quitarse, cuando está adherida a las tuercas, poniendo éstas en una solución de agua y bicarbonato de soda. Si se halla en las extremidades, frótense éstas con un trapo empapado en la misma solución. En tal caso, evítese que cualquier cantidad de ella caiga a los acumuladores de la batería.

Una vez que se haya quitado la corrosión a todas aquellas partes, se las cubre con una capa de grasa espesa o de vaselina.

Si durante algunos meses las baterías han permanecido recibiendo sus cargas periódicas, el único cuidado que exigen es el de llenar los acumuladores con agua tal como atrás se indica. Después de que ha funcionado por algunas horas, téngase el cuidado de comprobar la gravedad del electrólito por medio del acidómetro.

El valor total de los productos minerales exportados anualmente por la República Argentina asciende a cerca de $500,000. La inspección geológica del país está aún incompleta, y nada se ha publicado hasta el presente sobre tal punto. El laboreo de estaño principia a ser una industria importante, pero el estado general de la minería en dicho país es estacionario.

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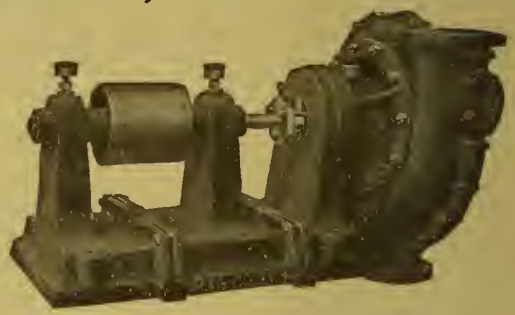

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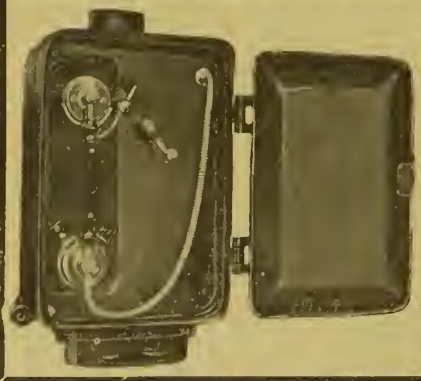

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A Letter from the North.

A good friend of the Journal recently left Mexico City and went forth on a tour of adventure and in quest of the main chance. He now writes from a point in Chihuahua that he not only has found a job but also succeeded in denouncing some extremely promising mining properties. His remarks about the wide stretch of country through which he passed while not altogether rosy still have the air of things hoped for.

He says:—"There is not much boom news around. I believe, though, that things are picking up and that it will not be long before there will be boom news. The country up here is peaceful and there is one thing you can bet on, that is that there will not be any more real revolutions around here. A lot of confidence is being shown. They are rebuilding the stations on the Central and the Durango line, and the fact is that the Central roadbed is better than it ever has been before. They are using a lot of cars from American roads, which makes it look as though somebody were getting confidence.

"In spite of Mr. Bryan the Americans are pouring into this country and they are not all looking for jobs either. A good many men are coming back to look their properties over and to make arrangements for going to work. They are dropping off the trains all along the line. The smelters in this section are all running. While they are not taking new contracts, they are buying ore on old contracts, and if the district remains peaceful a little longer, there is no doubt they will begin taking ore from everybody. The smelters are paying gold for ore and are charging freight and smelter charges in gold, making the calculations on the old charges at the rate of two for one. Therefore, the cost of shipping and smelting is the same as before the war."

Others who have traveled in the northern part of Mexico bring similar accounts. Evidently mining men need no urging to go back to work. All they ask is a chance.

Instituto de Minas y Metalurgia.

Readers will be pleased to learn that the local Institute, which has been languishing for some months, is in process of revival. This Institute, as everybody knows, is intended to do for engineers and metallurgists in Mexico what the A. I. M. E. does for those active in the United States. This association, which has for its object the discusion of all matters of interests to mining engineers and metallurgists, has for some reason never enjoyed the support that it deserved.

Why there has been this lack of interest no one has as yet satisfactorily explained. Certainly there has been no lack of interest in the topics which in this country fall within its scope, and there has been no lack of men within easy reach of the association headquarters who should have availed themselves of the benefits

there provided. Nor can it be said that men eminent in the profession have failed to lend their aid. Engineers such as the late Albert Grothe, G. A. and H. S. Denny and V. M. Braschi have given freely of their time and energy to make the Institute a factor in the development of the industry in the country. Yet of the thousands of mining men who constantly visit Mexico City from all parts of the Republic, comparatively few have taken an interest in the association founded for their benefit or availed themselves of its privleges.

Probably the best explanation of the failure to support more fully this worthy enterprise is that the prejudice, which still prevails in Mexico, against technical men willing to speak or write on technical matters in a technical way, has warned engineers, whose position is not yet secure, away from the monthly gatherings for fear of being classed with "those thereoretical fellows." That designation, "theoretical," has been a fatal one in Mexico of late years, why no one has explained. Perhaps some one has had a sad experience with theory running amuck. The Institute does not deal chiefly in theories; it should deal in facts and conditions, and if an occasional theory should creep in, that should be welcome, for really helpful theories are rather rare in mining and metallurgy.

Pyritic Smelting Again.

Some years ago the metallurgical world was in a state sf mild excitement about a new scheme, pyritic smelting. The idea of smelting sulphide copper ores, employing the heat evolved by the combustion of the ore itself thus saving carbon fuel for the process of roasting as well as smelting looked extremelly attractive and great things were predicted of is. Many practical and thoroughly experienced smelter men tried their hands at it. Some success attended their efforts; it was possible to eliminate considerable of the sulphur, but to work without fuel never seemed entirely possible. Some of the plants which claimed the greatest success with the new process employed from 8 per cent to nearly the normal proportion of coke on the charge. In some places where the conditions seemed to be right the scheme failed utterly.

Apparently here is a case where theory, apparently absolutely correct, failed entirely in practice. But it seems that the theorotical considerations while correct did not go far enough. All smelting apparatus had been through long years developed to employ carbon as fuel, and while burning sulphur and iron yielded heat the total number of units available and the conditions necessary were totally different. Fine ore could not be handled and the presence of alumina and magnesia introduced grave difficulties in fusion. So some stockholders were disappointed and one heard less and less about pyritic smelting.

Now the subject has been revived by the recital of experiences in Tasmania by Robert Sticht before the American Institute of Mining Engineers last December. Mr. Sticht had been connected with the early efforts in the field of pyritic smelting and he was called to Mount Lyell where he found conditions favorable and achieved a success hitherto unattained. He very modestly disclaims any great credit on the ground that the conditions were right and that without those conditions neither he nor any one else could have made the process fit the ore. He says: "It is much easier to find a proces to suit an ore than it is to find an ore to fit a process." Yet it was he that recognized the conditions and modified the apparatus to fit those conditions.

After long and successful experience certain important points in pyritic smelting have been established. Rapid running is essential, so that the rather small amount of heat developed may be utilized to the fullest. The furnace must be driven with a large amount of blast and to permit the passage of a sufficient volume of air the charge must be coarse ,large lumps of massive pyrite being an advantage. For the same reason the depth of charge may be increased. Alumina and magnesia are likely to from infusible compounds.

Although it is possible to run without coke as fuel it was found unprofitable to eliminate this source of heat entirely, because in the absence of all carbonaceous fuel the furnace requires excessively careful handling. At first one per cent coke was used but this was later increaed to three and even five per cent. By modifying the dimensions of the furnace at Mount Lyell it was possible to produce a satisfactory matte in a single fusion. It is pleasant to record that pyritic smelting has accomplished all that the early enthusiasts expected of it.

Mexico and the Antimony Supply.

Another reason why mining in Mexico should be revived without delay is that the armies fighting in Europe may soon need the antimony which the mines of this country could supply. The use of antimony in normal times though considerable is restricted. The present waste in ammunition is relatively enormous, and if continued for many months is likely to exhaust existing supplies. The metal is used for hardening the lead used in rifle bullets and projectiles for artillery. Rifle bullets contain from 8 to 15 per cent. antimony and shrapnel slugs about 12.5 per cent. It is estimated that an ordinary three-inch shrapnel shell contains a total of about 70 ounces of antimony. With continuous artillery firing, night and day along a front hundreds of miles long the expenditure of metal must be enormous.

Mexico has extensive deposits of antimony ore in Hidalgo and also in San Luis Potosi, in Oaxaca and elsewhere. From present appearances prices will soon be high enough to make it very profitable to exploit mines as yet unworked and to resume operations on deposits already opened. This is only one more opportunity for the enterprising miner in Mexico.

New Ways of Manufacturing Cyanide.

With the continuing difficulty of getting supplies of cyanide come numberless schemes for making this important chemical in ways hitherto unknown or ignored. Most of these are, of course, doomed to the limbo of all fruitless schemes, but to condemn them all to the same destiny would be unwise as well as unjust.

Cyanide of sodium or potassium contains no elements the supply of which is limited. Alkali, carbon and nitrogen are all abundant and inexpensive. The difficulty lies in inducing these elements to combine in the desired compound. It would be rash to say that the best and most inexpensive methods of causing this combination have all been discovered and utilized years ago. It is a significant fact that the present commercial supply of cyanide is manufactured by three radically differing processes. The present great need of the compound and the correspondingly high prices will doubtless bring out other reactions one or more of which may possibly be useful. It is well known that all the nitrogen in the blast does not pass entirely unchanged through the shaft of an iron blast furnace, and perhaps a reaction for the attachment of the nitrogen may be sought there.

To undertake to manufacture by a new process a product already fully on the market and in competition with old and established plants is usually a hazardous enterprise. The old plant can at first invariably undersell the new one. But the situation in regard to cyanide is now abnormal. The supply is short and it would not be difficult at present to secure prices several times the normal quotation. Never was a time more propitious for an enterprise of this sort than the present.

The development of a successful process from an original idea is notoriously long and laborious. According to a recent statement by the manager of the plant at Perth Amboy which is the chief source of cyanide for the United States, it took fully ten years to reach the present state of quality of output. And the process in use there involves the use of relatively pure raw materials, metallic sodium, ammonia gas and carbon. But promoters of new schemes are not easily discouraged and minor details will doubtless have no terrors for them. The situation is full of possibilities and may develop something interesting.

Colombian Emeralds.

Colombia, South America, is now the chief source of emeralds. As a source of these precious stones it was known almost immediately after the discovery of America, for the natives employed the stones as ornaments, in some cases attaching to them a religious significance.

Emerald mining is in Colombia a state monopoly; and the government exercises a strict control. The chief productive areas are near the capital, Bogota, the two principal ones being known as Coscuez and Muzo. At present the concession for the extraction of the emeralds is held by an English company with the right to work the mines for 20 years. The company is allowed to produce to the value of $1,250,000 a year only, the output being limited to prevent a depreciation of the market.

Mineralogically the Colombian emerald is a silicate of alumina and glucina with various other elements in small quantities, most important of which is chromium to which the green color is due. The specific gravity varies from 2.577 to 2.725. Fine stones of 5 carats are worth about $5,000 but gems of this size are rare. The emeralds of Muzo are celebrated for their color and water.

The matrix in which the gems are found occurs in layers imbedded in bituminous slate which when first exposed to the air is relatively soft, but which hardens upon exposure to the air. There are several areas of considerable extent within 100 miles of Bogota, all lying between 2,000 and 7,000 ft. above sea level. During the period from May, 1904 to February, 1905 the production from the Muzo mines, then the only property worked, was 262,548 carats of first quality, 467,690 carats of second quality, 22,700 carats of third, and 16,000 carats of fourth quality, with a total value of $900,000.

The Muzo group of workings is called the Mina Real, and has been worked since long before the Spanish conquest. The deposits were located in 1558 by a Spanish soldier, Juan Penazon or Penajos. A report of the English company states that the annual expense of mining is about $97,000 not including royalties to the government. The number of men employed varies, and there is considerable loss due to stealing, the average loss from this cause being as high as 25 per cent.

Costa Rica Mines.

Among the more important interests engaged in the mining industry in Costa Rica are the following:

The Albangarez Gold Fields, capitalized at $3,000,000 owns about 100 square miles of mineral territory. There is a 40-stamp mill with another 40 stamps under construction, and tube mills and other machinery for cyaniding. This same company also operates the Esperanza mines where the ore is crushed by 20 stamps and leached with cyanide solution.

The Union Gold mine is about 15 miles south of the Albangarez and is owned by California capitalists. Active milling is about to begin. The new leaching cyanide mill has 20 stamps, and the ore is expected to yield about $8 per ton.

The Montezuma mine, owned by New York capitalists, is about eight miles southeast of the Union property. It has a 40-stamp cyanide mill with all-sliming equipment.

The Aguacate property is owned by a New York corporation. It is building a plant and is employing about 1,500 men. The plant will have hydro-electric power from the Rio Grande, where about 5,000 h. p. will be developed and transmitted to the mine 20 miles away. The mine is about five miles north of the Pacific railway.

The Macacona and Corinto mines are owned by capitalists at San José, Costa Rica. These mines are situated on the Barranca river, about three miles from Esparta and about 12 miles from the Pacific port of Puntarenas. A 10-stamp cyanide mill is under construction and the property is under active development.

The Costa Rica Exploration Syndicate, a Costa Rica corporation, is developing the Arenal mines on the Arenal river 20 miles north of Albangarez. The property includes 25,000 acres of mineral lands, on which several veins of gold bearing ore have been located. This company also owns deposits of manganese, copper and iron ores on the Nicoya peninsula.

Secondary Metals.

The U. S. Geological Survey divides the metals used in the industries into two classes:— Primary metals or those produced directly from their ores; and secondary metals, those recovered from scrap and dross. Interesting statistics have been compiled showing what proportion of the various metals consumed came fresh from the mines and how much had already seen service in previous forms of manufactures.

It appears that in 1913 of the total iron consumed about one fifth was derived from scrap. Of the total copper output 22 per cent was secondary metal produced mostly by firms who make a specialty of treating scrap. Of the secondary lead more than half was recovered in the form of alloys. As regards zinc that recovered from scrap amounted to 23 per cent of the production of the smelters treating ores. Of secondary antimony 2705 tons was recovered nearly all of it in alloys. The production of secondary tin amounted in that year to 27 per cent of the primary metal imported.

It is not to be supposed that the difference between the totals of primary and secondary metals produced represents the actual loss to the world of these particular metals during that period. The use of metals in the arts and industries is still increasing, and it will doubtless be many years before loss and new production reach anything like an equilibrium.

Colonel Tepetate.

"How do you suppose all this war business is going to affect the fashions?" inquired Col. Tepetate.

"Fashions!" replied the astonished Pessimist. "How would I know? Come to think of it, the girls' clothes do seem to have a sort of military cut lately."

The old man smiled. "I wasn't meaning fashions in clothes, "he said, "I was thinking of fashions in mining machinery."

"Fashions in mining machinery! Who ever heard of such a thing?"

"True though. What else is it, all this switching around from one type to another and back again?"

"For instance."

"Well, take the good old stamp battery. It is like the hard-boiled derby hat. It never goes quite out, although they have tried hard to dump it. But look what they did to it. For several seasons they have been changing it around. They gradually increased the weights until the head was so long they had to take the front of the mortar out to get it in, and I heard of one mill that wanted to be in the height of fashion in which the whole side of the building could be taken out. And now that big stamps had got to be all the rage, see what they' ve done. The latest edict from fashion headquarters is, that heavy stamps are no longer good form. About 1250 pounds is the limit."

"Shucks! That isn't fashion. That's in the line of improvement. Everybody is looking for more economy."

"That's what I used to think, "said the old gentleman gently. "But I've seen so much of it that I am beginning to think there is some method in the thing."

"How do you dope it out?" demanded the Pessimist more or less bewildered.

"You know how women's clothes get their fashions, don't you. The manufacturers over in Paris would lose money if styles didn't switch at least every season. So they get some crazy artist to get up something new, something that will be sure to hit the eye. In the same way the machinery people hire an engineer—no reflection on his sanity—to get up something different. For you see it wouldn't do to let everything get standardized, for then every house would make just about the same thing and you might as well buy from one house as another."

"Roll over; you're on your back," sneered the Pessimist.

"You can see the influence of fashions working everywhere," went on the Colonel undisturbed. "Take the attitude of the companies. You can almost predict what sort of a mill they will put up by looking at them. A frisky, young outfit with bunches of capital is almost sure to have the very latest thing in mills, all the new wrinkles in pulpers, concentrators, all possible frills. But one of the old conservative concerns wouldn't think of doing anything so undignified. They will have nothing in the plant that has not been in use at least two seasons."

The Pessimist nodded. "Quite right too! Let the other fellow do the experimenting."

"And just as some people will go to extremes in clothes, so in machinery styles. When aeration and oxidation was all the go in cyaniding, some enthusiasts went so far as to poke air into the solution before it went into the zinc-boxes. Now the leaders of fashion are trying to give the poor old Pachuca a jolt and say that air in most cases isn't necessary at all."

"You can't touch an old standby like that."

"You never can tell. Hoop-skirts were in a long time but they finally had to go."

"You're trying to make us out a bunch of fools. We are in business for profit, not for show."

"Just the same we are all influenced by what the other fellow is doing. There are fashions of thought in all lines. Even Wall street has its fashions of financing. You have these waves in all things that occupy men, politics, religion, even science which ought to know better but doesn't. Just now everybody thinks war. In metallurgy everybody is full of copper leaching; but from latest dispatches it seems that flotation is going to supercede that. Perhaps next year leaching and precipitation will be in the discard."

"There is a very good reason for every one of those changes."

"Sure! And there is a very good reason for a tall feather sticking up straight on a girl's hat. I can draw the comparison further if you like. How is this? 'The latest decree from the volatile dame is that Wilfleys are not to be worn next season with straight riffles cut on the bias. A most striking effect is produced by introducing a reverse wave in the riffles near the hem. In most recherche circles in the Southwest the riffles are given an extra flourish curve, and straight slats are quite passé.' "

But the Pessimist had fled, his receding back eloquent of disgust.

The Florence, Colorado, Oilfield.

Written for the Mexican Mining Journal.
By Frederick W. Foote. *

This field lies along the valley of the Arkansas River about eight miles from the eastern base of the Rocky Mountains, and about thirty miles northwest of Pueblo. The Florence field is a large synclinal basin. elliptical in shape and about 8 by 14 miles in extent. The eastern rim of this syncline shows much abrasion, and at Kendrick Mountain two miles east of Florence, there is a typical example of an arrested anticline, which exposes the Apishpa formation. Towards the south, this rim passes into the southern ridge, which is at an acute angle with the Rocky Mountains, which in turn form the western boundary of the syncline. Towards the north, the rim passes into a double step-like fold, which carries the face of the range twenty five miles to the east.

The oil is found chiefly in the argillaceous Cretaceous shales of the Pierre formation, which contains local sandy strata of varying degress of coarseness. It is believed that both the source and reservoir of the oils is in this formation itself, and this is fairly logical, as shales are a recognized source of oil in many districts. On considering a section of the field, it is found, by means of well logs, that there are various horizons, which contain more or less productive sands. It is a known fact that oil is found more often in proximity of certain horizons than of others; but often no oil will be found in the strata in which it would be expected, while large flows occur with equal frequency from either the upper or lower oil-bearing bodies, or both.

No connection seems to exist between flows of the same horizon, except in rare instances, when one well will tap another and cause a marked decrease in its flow. The fact that these wells seldom influence one another, shows that the materials making up the oil bearing strata are in a different state of aggregation, and hence the oil is generally kept from flowing laterally any great distance, due to the fact that some portions may be fairly well cemented.

The percentage of successful wells runs a trifle more than 50 per cent, which shows that well locating in this field, like many others, is more or less a game of chance.

On striking oil in this field, the oil ascends in the well for from 50 to 1000 feet, due to the expansion of the gas, but it soon settles to a normal level. The wells yield from five to a maximum of 150 barrels per day, and in many cases the flow has been increases by further drilling. Torpedoing has not been successful, as the clayey material clogs the walls, and prevents a flow of oil.

Gas is found in small amounts, and is usually associated with oil, though in some cases it is found in non-producing strata. It has been known to exert a great force upon being struck, but usually there is just a steady pressure and flow during the life of the well. The gas thus found was at one time used in the city of Florence, but now it is only available for use in the near vicinity of the wells, being used principally in running some of the pumping apparatus.

Small quantities of water are met, but no relation seems to exist between the oil and water, as is common in the eastern fields. The wells remain dry even after depletion of the oil, and no back water pressure has over been noticed.

If the company does not own the land where they wish to drill, it is necessary to lease from the owner, paying a royalty on all the oil pumped into the receiving tanks in the yard. All accounts are based on the quantities received at the plant instead of at the pumping tanks, as there is but one man taking gauges, and increased accuracy is obtained.

In these oil fields, no casing is employed down to 2000 feet. When this depth is reached, a five inch pipe is employed, and if necessary a 4-¼" line below this. As soon as the casing is in place, the drilling proceeds with smaller bits than used formally. Using this means about six feet of depth are obtained per hour and about 80 feet a day can be counted on for the first 1500 feet, after which the process is slowed samewhat due to the length of time required for raising and lowering of tools. Four wells are dug continually, the deepest producing well being 3120 feet, the shallowest 1400 feet, while the average depth is 2400 feet. The average cost of drilling each well is $3000 but is must be remembered that only 50 per cent of the wells strike oil.

If oil is found, a field pumping plant is installed. Different kinds of power are used, namely: electric gas and steam. In this field, there is not sufficient gas for commercial purposes, as the total number of wells pumping simultaneously are about forty, and all are not gas producers. The total output approximates, 13,500 gallons per day. Well 49 was drilled in 1891, and is still pumping at the rate of 15-20 barrels per day. During these years, the yield has been 850,000 barrels which is considered a record for pumping well.

The oil, as it is pumped from the well, is received in a small tank of about 25 barrels capacity. It as an olive green color, a specific gravity of approximately 31 degrees, Baume, and contains on an average of 7 per cent gasoline, 33-one third per cent white or burning oil, while the remainder is residium, which goes to the by-products.

The crude is then pumped from the small field tank to the receiving tank in the refinery, and the gauges read at both ends to act as a check.

Pipe System.—The pipe system is essentially as follows: A series of 4" mains are placed in trenches, which are not laid out in any set plan since the ease of installing enters into all calculations. From the mains, are 2 inch laterals, which lead to the various pumping stations. In the same trenches with the oil pipes, are placed the water mains, which supply water for all necessary operations. The oil and water are both pumped to their respective destinations.

Distillation.—From the receiving tank in the refinery, the crude is pumped into the stills, care being taken to have the oil above the fire line, so as not to injure the still. If too full, trouble results and there is not enough room for expansion and boiling. The stills are of the boiler type and are heated by direct application of heat, a blowing system furnishing the artificial draft, through pin hole grates.

The vapors from the crude then pass out of the top of the still and into the condenser, cold water being used for the condensing medium. The successive products of distillation are as follows: Naptha, white oil, and wax. The oil pressed from the slack wax is known

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as pressed oil. This oil is run back to the stills and re-run for various grades of oil. The oil pressed from the hard wax is known as Foot's oil. This is run back to the wax distillate plant from which it is re-run for cracked wax. There is also a compounding plant in which various combinations of the different oils are made. An example of compounding is as follows: heavy machine oil stocks are compounded with sweetened neutral, making machine oils for heavy machines, e. g., journal boxes greasing cogs etc.

There is also a testing plant in which all the oils are tested and made to conform to the standard set for that oil. Here the tests for color, viscosity, flash point, specific gravity etc. are made.

Factory of Safety.

C. E. Stromeyer, before the Staffordshire Iron and Steel Institute, as reported in Colliery Guardian, points out that the expression, "factor of safety," was originally introduced for the purpose of inspiring confidence. It is generally understood that a machine or appliance such as, for example, a haulage rope or a bridle chain, with a factor of safety of say five, had been tested to five times the maximum stress for which it was designed, and in this general sense the term implies a margin of safety which seems to be an efficient safeguard oven against occasional overloading.

On the Continent it is more usual to employ the expression "permissible working load," or some such term, instead of factor of safety, and there is much to be said in favor of this practice. The factor of safety in its relation to winding ropes has recently been widely discussed in the German technical press, one of the main points raised being the influence of depth, and, consequently, of the increased weight of the rope itself upon the normal factor of safety. Col. Blackett alluded to the same subject when the regulations were before Lord Mersey. The regulations provide that the strength of cappings, in the case of haulage ropes, shall be based upon the ultimate strength of the rope, whereas the owners contended that the guiding factor should be the maximum load, as in the case of winding ropes. The distinction is subtle, but not immaterial.

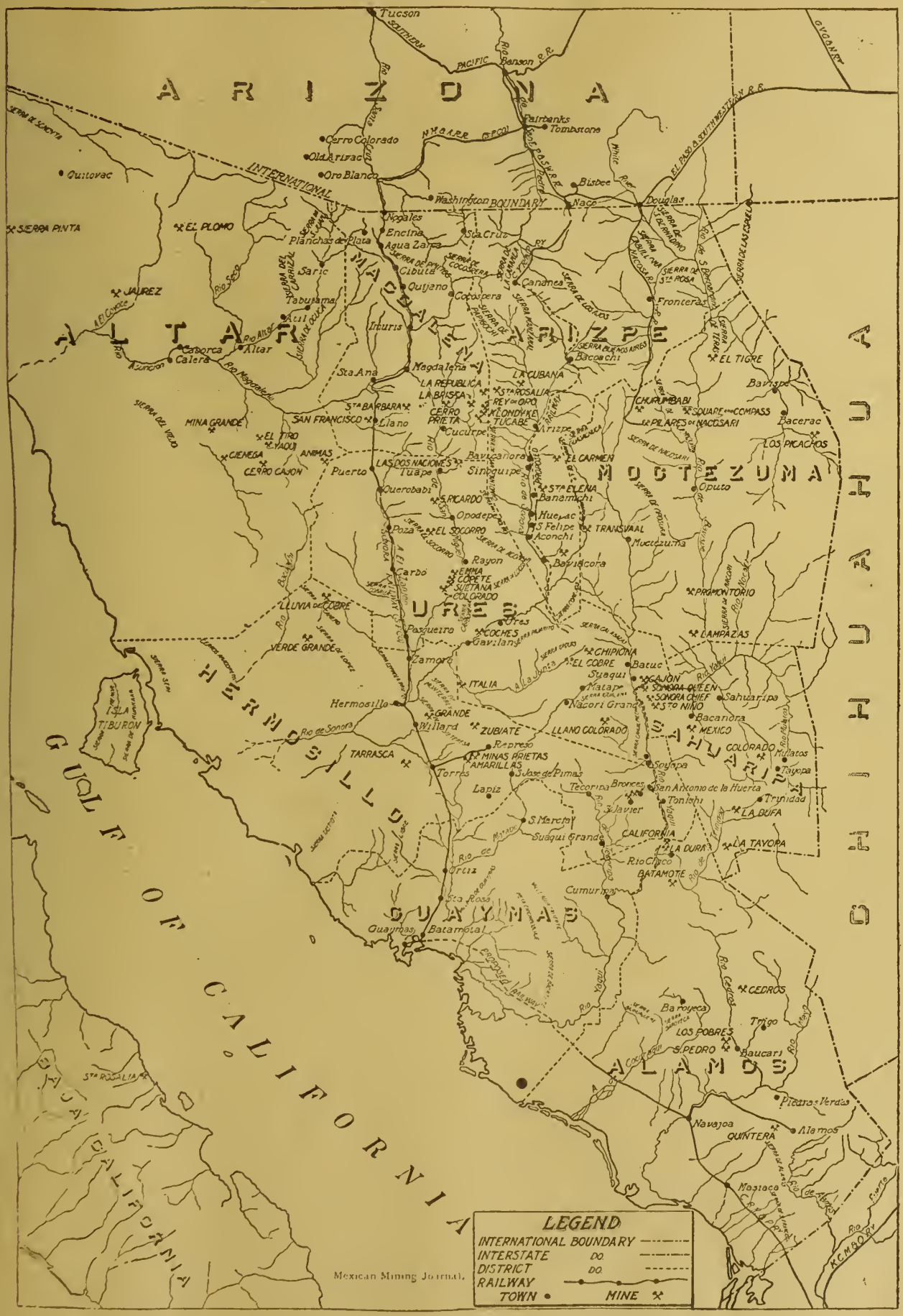
The term "permissible working load" posseses the advantage that a definite limit of safety is guaranteed by the manufacturer's tests. Factor of safety virtually means nothing at all. It is a figure obtained in part by laboratory tests, in part by mathematical calculation based upon assured knowledge which is frequently wide of the truth. As Mr. Stromeyer says, "the mathematical formulae used by engineers are of the crudest, and do not correctly determine the actual stresses produced by external forces." It is generally assumed that the factor of safety in, for example, a piece of metal, is the ratio of ultimate stress to elastic limit. Thus if the ultimate breaking stress is 20 tons, and the elastic limit is 4 tons, we say that the factor of safety is five. But it is not by any means an easy matter to determine either of these figures with accuracy. The utmost that can be done is to take the mean of a number of tests often widley divergent. Mr. Stromeyer, indeed, goes so far as to say that in certain cases the figure called factor of safety is made up of 50 per cent of mathematical convenience and 50 per cent of ignorance as to the true value of the elastic limit. The truth is that the elastic limit is a somewhat inconstant quantity. As we now know from the results of fatigue experiments, the elastic limit is reduced by repeated stress, and this is a consideration which possibly assumes great importance in connection with such appliances as wire ropes.

Influence of Conditions

Then we have the influence of the law of probability. There are innumerable small causes which may influence elastic limit one way or the other to a slight degree. These may generally tend to neutralise each other, but under certain conditions they may be cumulative. Thus if there are ten of these minute influences at work, each capable of influencing the elastic limit either positively or negatively to a slight extent, say, 1 ton, this will give 2.10 or 1,024 possible combinations of chances, giving a total range of 10 tons in the break down point, and there is one chance in 1,024 that all the influences will be adverse. Similarly we may calculate other chances, with the result that there is always a possible error, and also a probable average error, in the experimental determinations upon which the "factor of safety" figure is based.

Let us take anther case of the greatest inportance in mining operations, viz., the difference between static and dynamic stress, that is, between dead loads and live loads. In the text-books it is usually shown that a load which is applied suddenly results in a stress which is twice as great as that which a gradually increasing load will produce. Mr. Stromeyer believes that this is not true in all cases, and that suddenly applied loads often produce a much greater stress than double the static effect. We are here apparently in a state of profound ignorance, and have been too ready to deduce a general law from insufficient data. This question came recently into prominence in W. Walker's report on an accident at Rufford Colliery, due to the failure of a spring hook under a sudden jerk. The factor of safety as shown by testing was about 4.3, and it was admitted to have been insufficient under the circumstances of dynamic stress. It was, in fact, recommended in this report that ten should be a minimum factor of safety in connection with all ropes, chains, hooks, etc., used in such work as sinking operations. Even this margin is quite uncertain when questions of momentum have to be considered. Very similar conditions prevail in connection with the strength of winding ropes and more particularly of cage cappings. Breaking strains in such cases, as found by testing under a gradually increasing load, give but little information as to the results of a violent jerk, such as may readily be experienced in practical use.

The above examples go to show how mythical the factor of safety figure may be. Permissible safe load would seem to be a far more trustworthy guide in practice; but even in this case the term has only a limited application on account of changes due to the ageing of materials in use. A steel rope may start from the factory with a high breaking limit, but this becomes continually lower in use, partly as a result of continued and repeated stresses inducing fatigue, partly by reason of deterioration of the material. The latter factor is especially serious in the case of certain metals and alloys entering now somewhat largely into the construction of machinery of all kinds. Mr. Stromeyer remarks that the risk of ageing is so great that some engineers are becoming shy of using certain nickel-steel alloys and some brasses and bronzes, because these sometimes become absolutely rotten after a time, even although they may be perfectly satisfactory when new. There is much yet that remains to be investigated in the mysterious diseases to which some metals seem to be liable."


ARIZONA
ALTAR
MADERA
SAHUARIPE
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HERMOSILLO
GUAYMAS
ALAMOS
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GULF OF CALIFORNIA
LOWER CALIFORNIA
Tucson
Benson
Fairbanks
Tombstone
Cerro Colorado
Old Arivac
Oro Blanco
Nogales
Encinas
Agua Zarca
Planchas de Plata
Saric
Cibuta
Quijano
Cocospera
Tubutama
Altar
Caborca
Calera
Sta Ana
Magdalena
Inuris
Bacoachi
Cananea
Fronteras
Bavispe
Bacerac
Los Picachos
El Tigre
Los Pilares de Nacosari
Churubabi
Square and Compass
Sta Barbara
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Llano
Cucurpe
Arizpe
La Cubana
La Republica
La Brisca
Sta Rosalia
Rey de Oro
Londyke
Tucabe
Cerro Prieta
Mina Grande
El Tiro
El Yaqui
Cienega
Cerro Cajon
Animas
Las Dos Naciones
Tuape
Puerto
Querobabi
Sta Ana
Baviacora
El Carmen
Siriguipe
Sta Elena
Banamichi
Huepac
S Felipe
Aconchi
Trinsvaal
Moctezuma
Oputo
Opodepe
El Socorro
Rayon
Cardo
Emma
Corbete
Sultana
Colorado
Lluvia de Oro
Pozo
Pasquiera
Ures
Coches
Gavilanes
Zamora
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Promontorio
Lampazas
Chipiona
El Cobre
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Bronces
San Antonio de la Huerta
Tanichi
Trinidad
La Bufa
Lapiz
S Marcial
Suaqui Grande
California
La Dura
La Tayopa
Rio Chico
Batamote
Cumuripa
Sta Rosa
Guaymas
Batamotal
Cedros
Baroyeca
Trigo
Los Pobres
S Pedro
Baucari
Pitaya Verde
Navajoa
Quintera
Alamos
Mesiaca
Rio de Aburco
Rio Fuerte
Rio Mayo
Rio Yaqui
Rio Sonora
Rio Moctezuma
Rio Bavispe
Rio Yaqui
Rio Cedros
Rio Vaqui
Rio Mayo
Rio Fuerte
Rio de Aburco
Mesiaca
Sta Rosalia
Isla Tiburon
Isla Angel de la Guarda
Isla Partida
Isla Carmen
Isla Coronados
Isla Monserrate
Isla San Jose
Isla Santa Cruz
Isla Santa Catalina
Isla Cerralvo
Isla Espiritu Santo

Alamos—Promontorios Districts, Sonora.

Special Correspondence.

Owing to various causes, such as the low price of silver, the unsettled conditions in Mexico during the past four years, the paralyzed condition of business in general on account of the European war, and the difficulty of operating on a large enough scale to insure a profit, the three great old mines—the Promontorios, the Quintera, and the Minas Nuevas—have been closed down for sometime, but there has been a steady development. The following will give an idea of what has been going on.

The San Manuel, owned by Don Rafael Ibarra, has been quite extensively worked by a great open cut ten to fifteen feet wide and several hundred feet long, and from this winzes have been sunk so as to extract the grade of ore that can be treated in arrastras and values recovered by the patio process. Some six or seven hundred feet of work has been done in this way and the owner has made a living for the past four years from it.

This San Manuel is on the parallel lode to that on which the three old mines are situated, and it is this lode that has been the scene of the mining activities that have kept up interest in this famous old silver-copper camp during the past four years. The three old mines above mentioned have a wonderful record for their production of silver-copper (gray-copper) ores, and those who know best the facts going to make up their history assert that they have produced over $100,000,000 worth of mixed metals, since their discovery in 1720. The Prefect of Alamos claimed that these mines had averaged over a million dollars worth of products per year for over a hundred years, and those who have seen the mine workings and the worn out machinery about the mines have no reason to doubt his word.

Adjoining the San Manuel mine on the south is the Comete which is owned by Don Clemente Ibarra and has been worked off and on between crop seasons during the past three years. The ores have been treated at the owner's mill some two leagues south, at Las Arrastras.

The San José mine, owned or controlled by Mr. G. W. Du Bes, is about a mile and a half north of the San Manuel, and on the same lode or parallel contact to the great mines of the camp. The mine is now nearly 300 feet deep and being developed on quite an extensive plan. It has a good hoisting plant as all development is done by means of a shaft. The mine has about 1200 feet of work and something over a half a million ounces of silver ore developed and ready for reduction works.

North of the San José and adjoining it is the Planta-Fina property which has two prospect shafts, one of which is 115 feet deep. Here water was encountered and the work suspended owing to the same company having other interests nearby which could be developed without machinery, other than a windlass. Four samplings from the Plata-Fina workings gave an average of $4.40 gold; 54.3 Oz. silver; and 12.5 per cent copper.

Adjoining the Plata-Fina on the north is the Claraboya mine of Antigua fame. The owner has sorted over 100,000 ounces from the old dumps during recent years and treated the same in his mill at Las Arrastras. Don Clamente Ibarra is the owner and is now developing this mine by means of an adit tunnel which is cross-cutting the several veins of the lode at about two hundred feet deep. He has recently taken out ore the runs over 400 ounces of silver to the ton and 10 per cent copper. Seven veins have been crosscut and the results are very satisfactory.

North of the Claraboya is the extensive interests of the Plata-Fina mining company where work has been carried on in an economical way for nearly four years past. At this mine and the properties in this camp, there has been no molestation by any war elements during the trouble in Mexico. On this north end of the lode, the Plata-Fina company owns the Cacharamba mine and the Otilia, which was recently purchased, and is now under development, having a shaft 55 feet deep with cross-cuts into the several veins and an adit tunnel, from which winzes and cross-cuts will be run to explore the property as thoroughly as can be done before a hoist installed.

On the Cacharamba mine, owned by the same company, there are three shafts to the permenent water-level. Combined they have over six hundreed feet of development on ore. Two very fine ore-shoots have been explored as far as possible without heavy machinery and a pumping plant which the company intends to install in a very short while. The ores run from 10 to 4,000 ounces in silver and are free milling. Seven veins go to make up the lode and the pay streak runs from about a foot to five feet in each vein. These veins show signs of uniting at about 250 feet deep and a main double compartment shaft is being sunk on the hanging wall vein to encounter all the veins at their junction, where it is expected that a very large ore body will be opened out. The ore has to be hand sorted and naturally divides itself into two classes, one a shipping product running over 60 ounces per ton. The gold values in the ore vary from a trace to about 3½ ounces per ton, but appear to come in more regular where sulphides are encountered. The development work has been in charge of T. P. Brinegar, who has tried to take advantage of the liberal rates of exchange. A few miners who were born and raised in that section have been kept steadily on the job, as they prefered labor at a living wage to going as soldiers at any price.

The coming of the railway some seven years ago stimulated the better prospecting of this camp, and the result is that some six new mines have been fairly developed and only await a return to regular transportation and peaceful times to bring back to the district some of its former prosperity.

Sobia-Minetas

North of Alamos, at Sobia there has been a great deal of work done in the gold camp by means of Arrastras. Owing to the high rate of exchange, gold mining has been very profitable to the hundreds of old time gambocinos who have been thrown out of employment by the war.

Some forty miles east of Alamos, a new valuable mine as been opened by Mr. Geo. Bloom, who was in partnership with some capitalists of Hermosillo, Sonora. Mr. Robert Young, his foreman, claims that it is the making of a valuable copper-gold mine.

Some twenty miles further east at Pichicuate, is another gold camp that has been active also during the war. It is reported that much high-grade ore has been extracted and the lower grade reserved for milling. Several Americans who live "out east of Alamos" have never left the country on account of the war and never have been molested in the least.

Just west of Alamos at Navojoa, a crop of garabanzos was raised last year that brought to that section over $1,250,000 in gold, and owing to poor transportation and timidity over the war, but a small part of the lands suitable for this valuable food pea, were planted. Also large crops of wheat and corn were raised and this southern Sonora section suffered very little for lack of food. South of Alamos at Los Mochis, the sugar refineries produced over 20,000,000 pounds of sugar, and the crop now being harvested is said to be good for 25,000,000 pounds. Probably the very richest and largest body of undeveloped land in the world lies along the Gulf coast of Sonora between the Rio Yaqui and the Sinaloa line.

Mr. Jos. L. Obermuller of the Prieta mine at Minetas (Sobia-Minetas camp) has recently returned to Alamos and is getting ready to install a cyanide plant and treat the large tailings dump at the mine.

Mr. Paul de Bryan Cops has returned to Alamos and will open work at Durazno, some forty miles north of Alamos, just after the Holliday season is over. Some 18 months ago Mr. Bryan Cops discovered a valuable shoot of ore on the Durazno property. It is a gold mine and has much development and a mill. The high-grade ore recently discovered is said to run about $250 per ton, and this in shipping quantities.

System of Mine Accounts.

Charles A. Chase.*

The failure of the developed mine for lack of organization and technical skill is common and sad. At a time when business in general, your smallest grocer if you please, with his cash register and other appliances, is trying to make light the dark places, our industry remains in general archaic. I know a man of more than average intelligence, who runs a mine with the aid of a pocket memorandum and check book, as far as I can see. When the ore falls in grade, he will either change his methods or break. Unfortunately he is not alone in his method.

The necessity of right organization is common in all mines and is merely the application of business principles. To properly organize is to provide the mechanism, the staff of men for supervision and the system of accounting and communication to make their work effective. The aversion to accounting in general among mine operating men results from the inapt and cumbrous nature of some systems in use and inappreciation of the benefits to be had from a good system, fitted to the needs of the individual mine. When a foreman explains that there is a great deal of red tape on the mine, it is a fair inference that the system is wrong, or, if right, that man has not been taught to use it. Certainly, properly adapted accounting simplifies the work for manager, superintendent and foreman. There must be many figures, but the working out of the details of the accounting is to be concentrated in the hands of the clerk, where it belongs.

To the student of ways and means, citations from actual experience are of more value than theoretical conclusions and I will cite a particular mine and outline its organization and methods, as a good example. The mine is the Liberty Bell, and the system in use having antedated my presence there, I can speak of it from the standpoint of user and observer. These principles underlie the scheme: The provision of adequate executive supervision; the definite placing of responsibility; the definite knowledge of every expenditure; the definite knowledge of mill results; and the requirement that everyone is in a position of responsibility to tell in the simplest way just what he has done. The staff organization is thus: (1) General manager and president (non-resident); (2) superintendent (resident); (3) chief clerk and cashier, with necessary subordinate clerks and boarding house steward; engineer, with assistants as required by the work; mine foreman, with shift bosses and mine mechanic; tram foreman, with shift bosses; mill foreman, with one general assistant and shift bosses.

Each department head has well defined duties and a large measure of independence. In the system of reports and accounts is his bond with the superintendent and the latter's best means to gauge the work of the foreman. In the figures that come back to the foreman is his opportunity to know his own results. Any good foreman knows in some measure how his work progresses.

He cannot know this exactly without figures and this requires bookkeeping. If he does it himself it will be at the expense of his essential work.

Records of the Foreman

To illustrate the foreman's relation to the general system in telling what he does and what he requires in the way of supplies, I will take the mine foreman, who turns in the following sheets daily: (1) Mine labor report, which shows on its face how many men of every class were employed, surface and underground. (2) Mine ore report, which gives the ore and waste produced, and, what is to the point, if the tonnage of ore is below standard, the reason must be given there. (3) The daily log, a letter sheet which must go forward every day, blank or filled; if blank, the foreman assumes the responsibility of reporting good conditions. Otherwise the opportunity is at hand to call attention of the superintendent to any condition of the work; and, what is more important to the foreman, it offers him scope for his own ideas; it permits him to make recommendations. This report definitely places the burden of responsibility between foreman and superintendent. (4) Requisition blanks, numbered, form the simple means of asking supplies. Beside the statement of the want, the essential addition is the purpose. The foreman has at hand the list of headings, to which it is customary to charge mine supplies and labor: Foreman and shift boss, stoping, underground hauling, tunnel raise, blacksmithing, tracklaying and ditching, heating, lighting, telephones, air plant, electric plant, electric power, locomotives, cars, miscellaneous.

This short list the foreman knows and to the various headings he charges all labor and supplies. It is needless to say that the foreman retains copies of all reports and requisitions. These simple duties performed, he has fulfilled his part in initiating proper records. It is not complicated and cannot be a burden; in fact, the ordering of supplies is almost machine like at the end of each month. In return the superintendent supplies the foreman with the account complete at the end of the month, totals and summaries of all classes of labor and supplies and the cost per ton.

Reports of Department Heads

What the mine foreman does is typical of the duties of all foremen; and all reports go to the superintendent. In 15 minutes he will have entered the essential items of every report across his summary sheet. The entries on this sheet are, for the mine: tonnage, total labor, total underground labor, machine shifts; for the tramway: tonnage; for the mill: tonnage, total labor, amalgam product, concentrate product, tons cyanide solu-

* Mining Engineer, Denver, Colo. Extract from an address delivered to the miners of Idaho Springs under the auspices of the Colorado School of Mines and the Colorado Scientific Society.

tion and its value and other current assays. At a glance he can see whether any item shows change from the day, week or month previous.

The sheet is an index, par excellence. In the case of lowered tonnage in any department, the detail sheet gives the reason and so the case of high labor or any other irregularity. The recurrence of trouble in any quarter suggests that any remedy theretofore applied has not proved adequate. In a word, the signals are automatic, and there is the crux, the simplicity of the system. Foreman, superintendent and manager, all see the summaries, and, for all, the clear sheets, with full tonnage and normal labor, show the perfect working machine and allow freedom to study some particular part of the work and to improve practice.

The word distribution is used to designate the name of the account to which the foreman on his requisition signifies that the cost of the item he orders is to go. This is never lost sight of. The order to the supply house, written in triplicate, has the notation on the office copies, and, when the bill is received with the goods, it is entered thereon. At the end of the month there remain only the totaling of the various distributions and the entry in the books. The reports of the various departments are then compiled and analyzed.

Store and Construction Accounts

The esential remaining features of the accounting may be discussed together. Ideal simplicty would accrue if each item of labor or material could be given at once its proper and final distribution. This is not feasible, if one is to have the uniformity essential to comparison of results for different periods. The disturbing features are the purchase of some supplies in large quantities and the purchase and erection of machinery, buildings, etc., the former being distributed as used from month to month with exactness, and the latter approximately apportioned as depreciation through the assumed life of the mine. These equalizations are cared for by the "store" and "construction" accounts, respectively. Any purchase of supplies for use through and extended period, or for general use, is charged to the store when bought and then charged to the various departments at actual cost as used. All items going into any permanent construction are charged to their proper construction account, but after the construction is once complete, any further purchases are for repairs or maintenance and are charged off at once as operating expense.

I have given the salient features of a system that has proved of the greatest assistance in working out a difficult enterprise. My object in reviewing it is to drive home the fact that, as it touches the operating man, it is simplicity itself. It eliminates correspondence and conversation, the telephone being left for emergency use. It suits the needs of the staff men of all ranks. It is fundamentally the system that the small mine can adapt with profit.

I propose to use upon our organization the need of propaganda furnishing systems of mine accounting. The one fundamental principle should govern—the greatest accuracy compatible with simplicity and commensurate with the requirements of enterprises in various stages. Such work can be made invaluable.

The railway mileage in Brazil during 1913 was increased 1,438, making a total of 15,246 miles in operation, of which 2,185 miles are Government lines, 5,716 miles private leased roads, 3,447 miles granted to various enterprises by Government concessions, and 3,897 miles operated by private corporations under State concessions.

Tin Mine in Oruro District of Bolivia.

Berenguela Tin District, Bolivia. (*)

By Harold Allman Lewis.

This mining district is situated roughly half-way between the towns of Oruro and Cochabamba, or 20 leagues east or Oruro, in Bolivia. A branch railway is being constructed between these two towns, and the rail-head is now at Arque, slightly over half-way to Cochabamba. The nearest point to the mines is Colcha, a village at the foot of the Berenguela mountain, 2,500 to 3,000 ft. below the mines and about a league from most of them. Once the altaplanicie or plain of Oruro is left behind, the country becomes rugged and precipitous. The building of the railway on the descent from the summit of the hills (nearly 15,000 ft. above sea-level) bounding the Oruro plateau on the east down as far as the town of Arque may be classed as one of the engineering feats of the world. The streams crossed are among those that eventually combine to form the Amazon, discharging into the Atlantic ocean after traversing a distance of 2,000 miles.

On the Oruro plateau, at an elevation of 12,200 ft., no tree will grow, while in the valley of Arque at over 9,000 ft. lemons and peaches are produced in abundance. The facts that the Berenguela region is closer to agricultural districts and that the climate is less rigorous than in any other Bolivian mining district, are of economic importance as influencing the scale of wages, these being less than in any other mining camp in the country. The corollary is that, other things being equal, here should be profitably mined ore of lower grade than elsewhere in Bolivia. Nature apparently has preserved the balance by making the grade of ore average between 2 and 3 per cent tin, which is appreciably lower than the average of the famous mines of Uncia and Llallagua near Huanuni, and other localities.

Geology.

The Berenguela mountain is situated in the line of the Cordillera Real or eastern range of the Andes. The main direction of this range is northwest. Parallel with this range and west of it we have the Cordillera Occidental, with many volcanoes, the probability being that the upheaval of the Cordillera Real caused a line of weakness here, this being indirectly the cause also of the western range being formed subsequantly.

(*) From The Mining Magazine.

Tin mine, Oruro, where the tin occurs in iron and mica.

In a country such as Bolivia, to which as yet geologists have given but scant attention, it is necessary to deal in generalities. As regards Berenguela mountain, it is formed of alternating beds of shale separated by quartzite and sandstone. In places, in order to distinguish between quartzite and sandstone, it would be necessary to make a microscopic examination. Some of the slate on the west side of the mountain occasionally yields round balls, which, on fracturing, disclose impressions of bivalves and other shells. Sufficient distinctive fossils have not yet been found to enable the geologic age of these rocks to be determined. Fossil impressions are common on both sides of Berenguela mountain. On the west side of the mountain these alternating beds have been tilted, and in the main have now a strike northwest, dipping 30° northeast.

The principal lodes on this side cut the formation approximately at right angles, having a strike northeast and a dip about 45° northwest. Two productive lodes, however, having roughly the same strike, dip in the opposite direction. In some of the surrounding districts the shales and quartzites are overlain by Red Sandstone, but such does not appear to be the case at Berenguela. The range on the west side of the valley is capped by this rock and all the beds have approximately the same strike as those on the mountain, but they dip in the opposite direction.

From this the inference can be drawn that here we have a region that has undergone great lateral pressure, gradually being thrust upward, thereby forming an anticline that has parted ultimately at the top, giving us what is now Berenguela valley. The pressure probably continued, thus forcing the mountain to a still higher altitude and so exposing the Red Sandstone in this part more fully to glacial erosion, thereby accounting for the fact that on this mountain the Red Sandstone is no longer in existence. As a result, deeper strata are on view in the mountain than elsewhere in the district.

On the east side of the mountain the crumpling has been still more severe and the strata are found standind on end, the probability being that the valley on the east was formed by the old syncline. The lodes on this side mostly strike west and northwest, dipping east. The country throughout is much disturbed, and beds are seen with every imaginable dip; but the predominating strike is roughly northwest.

An interesting feature of the districts is that nowhere is there visible any igneous rock and therefore at present the nature of the underlying magma, which must have been the origin of the cassiterite and other mineral filling of the lodes, is matter for conjecture. At Quirquiavi, five leagues southwest, there is a lava-flow. There is another lava-flow in the hills bounding the east side of the Oruro plain, but this is twice the distance from Berenguela. In the Arque valley, at the foot of the mountain and 4,000 ft .below the summit, are found hot mineral springs of all temperatures up to boiling point.

One of the railway-cuts not far distant had to penetrate a cliff composed of quartz cemented together with native sulphur, which occasioned considerable difficulty owing to the blasting materials having a tendency to explode before the fuse could be lighted, because of the air causing the sulphur to become hot. It should be mentioned that the cut was not attacked in small sections from above, but that tunnels were driven for the purpose of utilizing heavy charges. Two leagues farther down the valley and alongside the railway, are extensive deposits of pure gypsum.

Mineralogy

Within the oxidized zone the vein-filling is chiefly limonite with broken and sometimes pulverized country-rock. The tin invariably occurs as cassiterite, even in the sulphide zone. In the oxidized zone I have rarely found minerals other than limonite, silica, and cassiterite. Occasionally the filling is composed of quartz and small crystals of cassiterite. The concentrate from milling, however, discloses a little silver with sometimes traces of copper and antimony. In the sulphide zone are found iron pyrite chiefly, rock-filling, and cassiterite, with occasionally stibnite and small amounts of chalcopyrite, these accounting for the traces of antimony and copper found in the concentrate. I have never seen any distinct ore of silver here; nor have I ever found specimens of either galena or blende, although both of these are reported as being found on the east side of the mountain.

The cassiterite has a marked affinity for one wall or other of the lode, especially for the hanging wall. Higher contents of cassiterite are almost invariably found where the lodes are in the sandstone or quartzite than when they are in the shale. Oxidation of the vein-filling extends to greater depth in the quartzite than in the shale. These facts are of considerable economic importance, for the recognition of them should influence any scheme of development.

Seven years ago I noted similar conditions in the Tres Cruces district, and it is probable that they occur elsewhere in Bolivia. I have never seen either apatite or fluorite in the Berenguela district; that is to say, I have not found any mineral containing either phosphorus or fluorine. It would appear therefore, that at the time of the deposition of the tin it might have been under such conditions as to have a great affinity for silicon. It is clear, at any rate, that from this particular district great masses of overlying rock have been removed, and it is, therefore, not too much to suppose that the tin was deposited under great pressure, and consequently under conditions of chemical combination totally different from those that obtain at normal temperatures and pressures as known to us.

No large defined crystals of cassiterite are found in this district. The cassiterite occurs either massive or in the finest powder, the latter predominantly.

Economic Geology.

The lode formation, as might be expected in sedimentary beds, shows considerable irregularity of out-line and has been largely modified by the faults and fissures formed at the time of the lateral squeeze. On the other hand, I have seen no sign of faulting subsequent to the period of ore deposition. Naturally, at surface there are cases where the shifting of rock-masses has displaced the lodes, and I qualify the above remark to that extent.

A usual type of fissure is that which has the form of a Z, or a series of them. The angles, however, are more often obtuse than acute. When the plan of a lode shows this form it is a highly encouraging feature, as a large deposit of ore may be expected at the bends and for some distance therefrom. Indeed, lodes of this type are persistent to the lowest depth so far attained in the district; the depth however is not great yet. That these bends are simply the natural fissuring of sedimentary beds prior to the formation of the lodes is seen from the fact that the vein-filling shows no sign of torsion, and in many cases an inch of the finest white clay will be found on the foot-wall continuing undisturbed round the bend.

Another type of lode is that in which the section shows this Z form of fracturing on the hanging wall. Here we may look for trouble.

On first driving along the vein nothing out of the ordinary may be observed, and good assays may be obtained all the way; also, it may be that the first rise will for a considerable distance disclose apparently a fair quantity of ore. Now is the time not to write home and report a very promising prospect. Subsequent rises will encounter what appears, at first and until considerable work is done, to be a fault; or it may even be supposed that there is a series of faults. This effect is caused by the country-rock of the hangingwall coming into the vein-fissure and over-hanging at the usual dip of the country. The effect is exactly as if the lode had been suddenly and effectively cut-off. There will be often as much as eight metres between the true foot and hanging walls. In places these blocks have broken clean off the hanging wall, giving an additional vein to be explored. The lode is found to be erratic and unreliable, and further prospecting will disclose the fact that the only places in which profitable mineral is to be expected are immediately under these overhangs of the hanging will. Under such conditions a large amount of prospecting in the end gives only a small amount of ore. If the first drift on such a lode is immediately under one of these overhangs, an erroneous inference is almost certain to be made as to future prospects. This type of formation would probably only be found in sedimentary beds.

The other lodes of the district are of normal type and call for no special comment. More movement, and therefore greater variation in fracturing, is apparent on the east side of the mountain than on the west.

Methods of Mining.

Operations, as is usual in Bolivia, consist of mining by adit. A cross-cut is run to the lode, which is then followed in the usual way and the necessary orepasses made. Close to the mouth of the main adit a ropeway is installed to take the ore to the mill, which is generally placed at a much lower level. No suitable timber is available for mining purposes, the best being a crooked tree called quehuiña, which yields a stick about 6 ft. long by 6 in. thick. It is a brittle wood and only useful in small drifts or for lagging. The importation of Oregon pine, costing B. 0.31 per ft. of board measure, or, say, 5½ pence, in Oruro, is out of the question for ordinary underground purposes. I do use Oregon pine, however, for chute-boxes. If a drift or adit encounters bad ground, the only thing to do is to put in rough walling and arching. This is a costly job, as the stone has to be specially selected, any stone with seams or flaws being useless, as it will split under pressure. Indeed, the best local stone will flake and finally split, and the walling and arching has then to be renewed. The quarry where the good stone is obtainable will probably be at some distance from the point at which the stone is required, roughly shaped, and brought to the point of application. Arch-stones cost on an average 15 c. or 2.7d. each, and wall-stones 12 c. or 2.1d., taking exchange at 18 pence per Boliviano.

A walling party consists of one pongo at B. per shift, helped by two miners at B. 2.60; a shift of the party therefore costs B. 9.20. To wall and arch two meters of adit in average ground, with resulting dimensions in the clear of 1.80 m. high by 1.20 m. wide, the following is the cost:

5 Shifts of walling party	B.46.00
112 Wall-stones at 12 c.	13.44
50 Arch-stones at 15 c.	7.50
Total	B.66.94

Some allowance for tool-sharpening should also be made, and therefore if the price per metre is put at B. 35 it will be a close approximation; that is, walling and arching, exclusive of driving, costs £2. 12s. 7d. per metre.

Where the veins are narrow and the country-rock sound, methods are normal and require no comment. Some of the principal lodes, however, are wide, at any rate in parts, and the hanging walls are bad. When such lodes dip at about 45°, the question of extracting the ore becomes matter for careful consideration. Any sort of effective timbering is out of the question.

The conditions obtaining in one actual case were the following: Above a certain level the ground was worked-out and the stopes filled. Below this level the lode widened to a maximum of 6 metres. The next level below was distant 80 m., measured on the dip, which was 45°. The method of stoping was as follows: Suitable winzes having been sunk, sub-levels were driven about 20 m. apart. The winzes were a source of much trouble, as the drywalling was perpetually getting out of place; in the event, they were only able to be kept open long enough to see the work through. Stoping commenced in the upper sub-level, which was first widened to the full size of the lode and the roof supported, wherever it showed signs of weakness, by pillars of dry masonry. Next, the actual stoping began; a horizontal cut of about 18 in. being taken along the whole length of the stope, starting from the hanging-wall side, avoiding the pillars and leaving the foot-wall until last, so as to get an arching effect; the ore falling down passes to the cars on the main level below. Filling was then run down special passes, from the old stopes above, and spread evenly over the floor. After filling, the space between "gob" and back was only sufficient to allow of a man passing on hands and kness. Next, dry wall-pillars were erected on the filling, and the old ones taken out; the stones being specially selected and valuable. The above order of events was repeated over and over again until the sub-level was stoped-out. The same course of procedure was adopted in No. 2, which utilized the filling from No. 1, which latter was then allowed to cave.

To avoid shovelling as much as possible, side inclines were made from the waste-filling passes so as to distribute the material; and also into the chutes, for the readier handling of the ore. No supporting pillars were left under sub-levels. When the stope from No.

2 sub-level approached No. 1 a rise was made at the inside end of the stope into the filling remaining in No. 1. The shell was then sliced till it caved, bringing down the remaining ore and filling the stope behind with waste. This caving was continued forward till the remaining shell was extracted and the stope filled. The length of the ground thus attacked was 40 m., and the average width about 4 m., with a maximum width of 6 m. Big caves occurred on the hanging wall, and these large blocks were broken for use as filling. The chief danger was not so much from the hanging wall, as from the fact that part of the lode was formed of fine stuff, closely packed, which could not be "sounded" and was liable, therefore, to come away without warning.

As showing what can be done with the inefficient native labour, if properly supervised, it is necessary to add that the above stoping was carried out by Charles Albertson, the mine captain, without other white assistance.

At the Tucsuhuma mine, in the south-easterly portion of the district, underground operations are confined to prospecting; the ore for the mill being obtained by quarrying a large deposit at the surface of the hill and immediately behind and above the mill. The Tucsuhuma people estimate that they have ore for several years ahead of the mill in this quarry and so are better off than most Bolivian mines, where the lack of development can best be described as chronic.

I do not imply that special credit is due to the Tucsuhuma people on the score of having kept development well ahead intentionally (the surface deposit was discovered fortuitously, comparatively recently) but that they are specially favoured by a natural occurrence. The Tucsuhuma lode strikes parallel with the crest of the hill and dips parallel with the surface of the hill and almost as flatly, the result being that a comparatively large body of ore is put in sight by the mere fact of the lode, which is from two to six metres wide, dipping at 45° and outcropping on the side of a hill the surface of which slopes at about 35°. The quarry is several hundred metres long. Cross-lodes extend into the hill. In places the country-rock carries cassiterite in minute fissures partaking of the nature of a "stockwerk." Such occurrences rapidly increase the available ore reserve. Sulphides are encountered at only a few metres below the level of the quarry.

Description of Mines

This district has been known as a mining region from ancient times. Tradition has it that there are 400 antiguas on the hill and that at one time the Spaniards had 2,000 Indians working here, till the latter revolted and killed their masters. The number and extent of the old workings and old dumps is surprising. Since ancient times the mines have not been worked seriously until in quite recent years, when they were avowedly worked for tin. Yet, thousands of tons have been taken out of the best tin lodes by the ancients. Did the ancients work these lodes for silver?

Concentrates, where the concentration has been 40 into 1, produced from ore from the same part of the same lodes carry today 6 oz. silver per ton. I have never heard it said that the Spaniards exported tin from Alta Peru.

Another theory to account for the existence of such extensive old workings on tin lodes is that the Viceroys being unceasingly pressed from headquarters for silver, augmented the supply with tin, either by alloying or by having tin used locally for silver. Against this idea is the lack of old Peruvian coins containing a large proportion of tin. If that is not so, the only other explanation is that the Spaniards had an enormous amount of prospecting done by their slaves, the Indians, on the off-chance, merely, of finding silver. Perhaps this is the correct solution; in which case, it is difficult to account for another local tradition to the effect that a lost mine in this district produced fabulous sums in silver.

The principal mines of the district are Berenguela, Tucsuhuma, Jatunkaka, Empresa Hornuni, and Leque; there are numerous other small prospects. Of these, Berenguela and Tucsuhuma have been producing for some years with the aid of machinery. Jatunkaka has been devoting attention to development while maintaining a small production of barrilla with hand appliances. A modern mill is now being erected. Empresa Hornuni has a peculiarly arranged mill and a mine that is not opened-up, but is well regarded by the miners who have worked there. The mill is driven by a portable steam-engine. As firewood, delivered at Hornuni, costs B. 3 per quintal of 100 Spanish pounds, the plant can only be run at a loss. Taquia (llama dung) and yareta (a species of moss) are not available in this district. Leque is a promising prospect producing a few quintals of barrilla each month by hand appliances.

Local Mills

It is perhaps hardly fair to describe too minutely the methods of tindressing employed at the moment in this district, for the reason that both the mill at Berenguela and that at Tucsuhuma are undergoing improvements. There are no other mills using machinery in the district. The method of grinding and dressing tin ores by hand appliances in Bolivia is decidedly interesting, and, in the case of rich ore, not nearly so inefficient as might be imagined. A great advantage of the system is that practically no big outlay has to be incurred.

In considering the design of a mill, or improvements to an existing mill, in this district, and in most others in Bolivia, the following points must be borne in mind.

(1). Any machinery will probably have to be purchased out of earnings.

(2). Machinery will probably have to be sectionalized.

(3). Excessive cost of power limits the number of machines it is desiderable to run.

(4). The chief aim is not so much to attain to theoretical perfection of recovery as to get the biggest possible return for money spent.

As an example of (3) most of the concentrate in the Berenguela mill is taken from the tables comparatively dirty and is cleaned by hand, in order to give greater capacity and diminish loss in tailing.

The form of power mostly favoured is the Diesel engine burning paraffin, this being the only form of fuel packed in tins of size sufficiently small to be handled by llamas. Later it is hoped that the railway will see its way to carry crude oil in tank-cars to Colcha.

The Berenguela mill consists of ten 650 lb. stamps, in steel frames (which are unsatisfactory), two trommels, one 2-compartment Harz jig, one Wilfley and one Buss sandtable, one 3½-ft. Huntington mill for regrinding, two 6-ft. vanners and two 4-ft. vanners, besides several square and round buddles for cleaning concentrate. The Huntington is not running, and two revolving decks for the treatment of slime are yet to be put in operation. Hydraulic classifiers are to be substituted for the trommels and large conical dewaterers are being installed.

Power is furnished by two 20 h. p. Sulzer Diesel engines with a 12½ h. p. Hornsby-Ackroyd in reserve. These Diesel engines burn, roughly, four tins, of five American gallons of kerosene each, per 24 hours.

The Tucsuhuma mill consists of two ballmills (one in reserve), hydraulic classifiers, one Harz jig, three

Humboldt sand-tables, two overhung vanners, and one revolving deck, besides settling-tanks and pumps for return of wash-water. Power is furnished by one 20 h. p. Sulzer Diesel engine with two 8 h. p. two-cylinder Deutz oil-engines in reserve.

Particulars as to the new mill just begun at Jatunkaka are not yet available, although it will be probably more complete than either of the above, as I infer from the fact that two 30 h. p. horizontal Diesel engines are being supplied.

Assaying

It may be of interest to give a short description of the methods employed at Berenguela: 25 gram. of ore or concentrate ground to 100-mesh is digested in a flask with hydrochloric acid, then 5 c.c. of nitric acid added and digestion completed. The flask is then filled with water to the brim and inverted upon the vanning-shovel, by which means the solid contents of the flask can be transferred rapidly without loss. As the residue consists entirely of cassiterite and silica, washing on the shovel is simple. The resulting concentrate is dried, weighed, and estimated as follows:

If the sample is a shipping concentrate, product is estimated as 77 per cent; if rich ore 75 per cent; if battery-feed sample 70 per cent; if low-grade stuff 65 per cent tin.

The reason for the varying scale is that it is not advisable to wash low-grade ore so clean as a barrilla, since greater loss would ensue. This is a rough and ready method that gives results close enough for every-day use.

The other method employed is the Pearce assay, using sodium peroxide in iron crucibles, reducing with iron, titrating with deci-normal iodine solution, and standardizing against metallic tin, made by fusing the cassiterite with cyanide. Titration is done as quickly as possible. Sulphide ore has to be roasted before employing this method, otherwise the charge is liable to explode if the proportion of sulphur is high at the time of fusion with sodium peroxide.

The finer the sample is ground, the better. Time is a great consideration on a mine, and if the sample is ground to 100-mesh and assayed in duplicate, the result will probably be equally as accurate as the original sampling underground. To labor in order to make mine assays agree in the second or even in the first place of decimals, is waste of time on a tin mine.

Titanium, tungsten, and bismuth, are absent.

The following experiment is of interest: 0.6 gram. of iron filing was fused with sodium peroxide in an iron crucible, reduced with iron, and titrated. The amount of iodine solution required was 0.2 c.c., which, with that strength of iodine solution, was equivalent to 0.06 per cent Sn on a 2 gram. assay. 0.6 gram. of filings was taken, as being equivalent to 30 per cent Fe on a 2-gram. assay, and a greater percentage of iron would not be expected in ordinary mine-work. The result shows that large quantities of iron, fused in iron crucibles and reduced with iron have a negligible effect as far as any ordinary mine-work is concerned. Boiled, not distilled, water is used, as the latter is not available. The boiled water requires one drop of the iodine solution. The starch solution is made fresh every day.

Costs.

It is not within the scope of the present article to give detailed costs per ton of ore mined and milled and of barrilla produced, nor to tabulate milling results, as recorded here at Berenguela. Nevertheless, some general figures may be useful to those stodying Bolivian mining conditions.

Exchange fluctuates, although not to such an extent as in Chile. The Bolivian dollar is at present worth 17¾d., whereas a year ago it was worth one penny more. This fall is largely influenced by the fall in the price of tin, and this fact, that exchange is sensitive to the price of tin, is of appreciable assistance to Bolivian operators. This important and interesting dependence of Bolivian exchange on the prevailing price of tin is due to the fact that a considerable proportion of Bolivian revenue is derived from the export duties on tin ore.

The scale of export duties ruling today is as follows:

Price of Straits Metal.	Export Duty in Bolivianos per metric quintal of 100 kilo.
Below £100.	2.00
£100—£110.	2.20
£110—£120.	2.85
£120—£130.	3.50

The rise being 65 cents for every ten pounds increase in price of Straits tin in London. The official table is calculated up to a price of £300 per ton. The ruling rate is fixed by the authorities once every fortnight and the price of tin taken is always slightly above that which actually ruled for the previous fortnight. In other words, the Government favours itself.

The scale of wages ruling in the Berenguela district is as follows: Transport of barrilla to Oruro is effected by llamas, the cost per quintal of 100 Spanish pounds being B. 2. A llama will carry one quintal. 71.7 Spanish quintals is a close approximation for either a metric ton or the English long ton; it is, however, somewhat under the latter. A close approximation for the cost of concentrate, assaying 60 per cent tin, from the mines of this district till sold in London, including all charges whatever, is £36 per ton. With tin at £130, a ton of 60 per cent barrilla, is worth £78; therefore the margin is £42 to cover mining, milling, repairs, depreciation, office, overhead, and any other charges. It is clear that £130 for tin is pretty close to the limit, below which most Bolivian mines will fail to pay expenses.

Conclusion

Although this district has been known from ancient times, it can be said that little is yet ascertainable as to its ultimate future possibilities. In general, it can be said that the more the different properties are explored the more encouragement is obtained to pursue investigation. One noteworthy feature is that all these mines or prospects are situated on one hill and within a relatively small area. The railway is at the foot of the hill. There are two main streams at the foot of the mountain, either of which would be capable of furnishing 150 h. p. per kilometre. There is, therefore, plenty of hydraulic power available in the district.

As in all tin mines, the future will depend on the ore encountered in the sulphide zone. The lowest working in the district discloses pyrite richer in cassiterite than the oxidized ore at present being mined. It would seem, therefore, that some day all the mines will become one concern, united by ropeways to a central mill alongside the railway, and that hydro-electric power will replace the small individual Diesel units. The scale of operations would be increased many times and the cost of production would be one half of that at present obtaining.

Oil and Mineral Rights in Panama.—Consul General Alban G. Snyder calls attention to the decision just rendered by the supreme court of Panama that oil fields are national property and can be disposed of by the nation. The court sustained the recent law, by which the government reserves for itself the right of ownership to such natural resources as mines of gold, silver, or other metal; also of coal and oil which might be found in waste lands sold to private individuals by the government.

Eastern Nicaragua.

By an Occasional Contributor.

The gold producing district of Eastern Nicaragua may generally be defined as extending north from the Escondido to the Wanks river and westward from the coast for a width of 100 miles. Mining activity has been confined mainly to the districts drained by the Pis-Pis river. The first mine to open up on a scale of importance was the Siempre Viva, which has now been producing 20 years. Other mines were opened from time to time, generally upon a small scale, building themselves up out of the profits, as in most instances the work was undertaken by men of small means, until at present there are nearly a score of properties being operated.

Bonanza Mine, Pis Pis District, Nicaragua.

The types of deposits comprise veins and impregnations of irregular shaped bodies of decomposed porphyry. The deposits are usually oxidized for a vertical depth of 300 to 400 ft. Above the water-level, from which all the gold so far has been produced, the ores are usually friable, with a tendency to being clayey. Light stamps are used in some of the mines, especially where the ore is more than usually hard, but in the greater number of deposits the ore is too soft for stamp-milling, and in such cases 3½ to 5-ft. Huntington mills are employed, and are particularly well adapted to the ore. Surface disintegration of the outcrop often results in the formation of a mantle of rich soil spreading outward from the orebody as a centre, covering much more surface than the original outcrop. This is locally called a **manta**. These **mantas** are often of great extent, and the material being in a fine state of subdivision, permits recovery of the gold by most simple means, such as sluicing; and from the working of the **mantas**, especially if rich, sufficient returns are obtained to explore the orebody or even pay for the erection of a small milling plant. Narrow, isolated, well-defined veins are frequently found, known as **hilos.**

By far the greater number of the known ore deposits are situated in hills, so that the ore may be mined by open-cuts, with a system of adit-levels below for tramming out the ore, which is broken down into the mill-holes rising from the adits to the bottom of the cuts. No hoisting has been done to any extent in any of the mines, nor has the water-level been reached, except in one or two instances. Systematic development and creating an ore reserve are practices unknown in the district. Stoping has been done to a small extent, but entirely from one or two shallow levels driven along on the strike of the deposits; never at a deep level. Some of the mines, where work has been carried to the vicinity of water-level, show the presence of sulphides, galena, blende, copper, and iron pyrite. Usually there is little difference in value between the oxidized ore near the surface and that from the lower limit of the zone. Not enough is known of the deposits at or below water-level to make any statement as to the change in value of the ore. At the Santa Rita the sulphides contain about as much gold as the surface or oxidized ores. This deposit is a mineralized mass of decomposed porphyry, the ore at water-level being a mixture of chalcopyrite and pyrite, the gossan cap of which, some 400 ft. deep, is being worked for gold.

The metallurgical operations are most simple. Amalgamation alone, or followed by cyanidation of the coarse tailing, is the practice at all places except Santa Rita, where the coarse sand is separated from the

Lone Star Property, Pis Pis District, Nicaragua.

tailing and re-ground, thence to pass over amalgamating and blanket-tables. The tailing from this operation contains too little gold to pay for further treatment. Some of the mines are now reaching the deeper zones of ore, requiring much greater skill and more elaborate methods to economically win the gold content.

Where a supply of water can be obtained for power the first cost of a milling plant and the expense of operation is greatly reduced. The Pis-Pis district is more favorably provided with water-power than the Oóconwas and Banbana districts. The largest hydro-electric plant is that of the Siempre Viva mine, situated below the falls of the Pis-Pis river. This company rents

Going over the Falls on the Prinzacola River, Nicaragua.

power to some of the neighboring mines, and if the total power the falls could be made to supply were availed of, power enough might be generated to run nearly all the mines of that district. Where a steam-plant is required, there is usually an abundant supply of wood for fuel, which, if a long haul is not required, can generally be laid down at the boilers for $3.50 U. S. Cy. per cord.

During the dry season many mines depending upon water-power are obliged to close part of their plant, and during exceptionally dry weather there often is a shortage of water for milling purposes, even at those plants where steam-power is used. In most instances a pumping station placed at the riverside could be utilized during the dry weather without causing a prohibitive increase in operating expenses.

Passenger Transport on the Prinzacola River, Nicaragua.

The country is sparsely populated; but so far no one has been annoyed to any great extent by shortage of labor. Mosquito Indians, Nicaraguans, and blacks from the West Indies comprise the available labor supply. Should operations at the mines ever exceed the supply of labor the country can furnish, abundant labor could be brought in from the West Indies. The part of Honduras bordering on the east of Nicaragua is very sparsely populated, and could not be counted upon as a source of labor. The interior of the country might furnish recruits, but as a rule the natives do not care to come down to the lowlands of the coast.

Almost all food-supplies are imported from the States. The laborers' meals comprise rice, beans, bread, coffee, and fresh meat. Most of the mines have made no attempt to cultivate their territory with a view to raising their own foodstuffs. The soil is generally productive and several crops per year may be realized. The natives would be content with what the soil could produce, and by cultivation of the land, imports of foodstuffs could be reduced to lard and such supplies, that cannot be grown. The labor is very efficient—the best I have seen south of the Rio Grande—but the malarial fever of the coast makes it necessary for most of the mines to keep on hand more laborers than ordinarily would be required, to replace those who lay off from sickness. The natives, especially the Indians, are nomadic, and rarely stay in one place more than three months at a time. Silver money is in circulation, paper being unknown. The current rate of exchange is 38c., U. C. Cy., as the equivalent of one sol. Coinages of all the Central and South American Republics pass at the same rate. The amount of coin in circulation is far from enough to supply the mines; liquidation of laborers' accounts has to be made in greater part by means of drafts on the merchants, the laborers exchanging them for merchandise and such cash as they can get.

The coast of mining and milling do not vary to a great extent in the different districts. Mining by the open-cut method costs from 12 to 30c., U. S. Cy., per ton; milling, from 45 to 80c.; other charges bring the costs up to $1.25 to $2 per ton, depending largely upon the size of the plant. Cyaniding of the sand costs from $1.10 to $2 per ton. A two 5-ft. Huntington-mill plant, operated by steam-power, can be installed in most places for an expenditure of $20,000; the accessibility of the mine affects the figure to a great extent. A cyanide plant to treat 80 tons of sand per day would cost in the neighborhood of $60,000 for a simple leaching equipment for sand, and no facilities for treating slime. This figure would not include any grinding machinery.

The rivers rising in the foot-hills of the eastern mountain chains of the country flow eastward into the Caribbean. They are navigable for the lower 60 miles by any vessel that can cross the bars at their mouths, where usually there are not more than 4 or 5 ft. of water. The Escondido and Wanks rivers are navigated by river steamers; the whole of the Principulca and Banbana and the upper waters of the Wanks, Wasspuc, and Pis-Pis are only navigable by native dugout canoes or pit-pans, the largest of which carry cargoes of 13,000 lb. At the head-waters, near the end of canoe navigation, rapids are found in the rivers, but covered usually with enough water to permit the pit-pans being hauled over. Some of the mines have to pack their freight by bullteams for several miles. In the rainy season the rivers are subject to inundations often rising 40 ft. in a few hours.

Fruit steamers ply between New Orleans and Bluefields and Cape Gracias a Dios. Freight for Principulca is carried up the coast in small gasoline schooners. The freight from New Orleans to the mines varies between 4 and 8c., U. S. Cy., per pound, the higher rate representing the cost at mines where hauling by bulls has to be resorted to. No import duties are collected for mining machinery; all foodstuffs for the mines, except those granted under concessions, are subject to a high import tariff.

There is an export duty on gold at the rate of 50c., U. S. Cy., per fine ounce of metal, payable in Government bonds under a penalty of an increase of 50 per cent. Before the miners had a chance to buy a supply, speculators cornered the entire bond issue, and sold again at an increase of very nearly 50 per cent. The export duty is considered a hard burden by the miners, and rather unjust, as the whole business of the northern east coast is dependent upon the mining industry.

All the mines so far have been opened by people of small means, who increased their scale of operations out of the profits of exploitation in a small way. The country is extensively mineralized, the ores being of low medium grade as a rule, ranging between the averages of $4 and $10 per ton, and no bonanzas have been discovered, but have never been worked except by crude methods and spasmodically.

In parts of the country very good prospects, with extensive **manta** deposits, sufficient to warrant opening on a small scale, and with exceptional promise of finding a fair-sized orebody may be obtained, at prices ranging from $1,000 to $15,000, U. S. Cy., under terms of payment which will permit of considerable exploration, opening up and erection of a small mill, for about $25,000, and if operations be commenced at once, they permit of making the greater part of the payments for the property out of profits. There are many prospects showing a long and continuous outcrop or **manta** of ore of sufficient value and large enough extent to warrant the risk of the amount mentioned. In this way most of the mines have been opened that are now being profitably worked. There have been some failures, but not many, and in most instances failures resulted in attempting to exploit prospects which held forth not one iota of promise from the start. Those who will neither take too optimistic nor pessimisistic a view, who can estimate the probable worth of an undeveloped deposit, and will risk a comparatively small sum, will be the ones to open up the country.

There are no actual ore reserves in any of the mines, and a field for investment of large capital would be restricted to buying up those mines which have been profitably producing for the past four or five years. While, strictly speaking, these mines are undeveloped, still the work that has been done is sufficient to reveal the nature of the deposit, allow an appropriate valuation of the ore being made, and a reasonable estimate of the probable future life.

Could several of the larger properties be combined under one management, with a staff of capable engineers, with capital enough to enlarge mills, permit clearing the rivers and improving transportation, the profits from many properties could be greatly increased, and certain of them now barely paying expenses might be made to yield handsome returns. Many small properties have not been profitable simply because the owners could not afford to carry a sufficient supply of repair parts for the machinery, and break-downs caused delays, permitting expenses to run up beyond hope of recovery before their mills could start again.

The climate is typical of tropical low-lands. The land is poorly drained, covered with a dense tropical forest, and infested with malarial fever. The more pernicious tropical diseases, such as yellow fever, bubonic plague, berri-berri, and the like, are unknown. The rainy season lasts from the middle of May to the end of November, during which time the greater part of the 130 inches of average annual rainfall occurs.

How long will it take the public, mining and otherwise, to learn the facts expressed so tersely and pithily elsewhere in the present issue. A prospect, says the writer, in effect, is a gamble; a mine without ore reserves, a speculation; and a mine fully developed, an investment. Capital is never really interested until you can show it a sure thing.

Methyl orange can be used in the titration of sulphuric acid in solutions containing copper sulphate, the color change being from reddish violet to greenish yellow. Larger amounts of the indicator than usual are used, and the titration carried out slowly at the end. Results given are fair.

Notes on the Use of Potasium Permanganate as Cyanide in Sand-Filling Solution.

By R. A. Cooper.

During the routine analyses to determine the degree of decomposition of cyanide in the operation of the sand-filling plant, it has appeared on several occasions, where from some cause the permanganate had been omitted, that the cyanide contents were not materially affected. To verify this a series of special samples was taken. These were as follows:—

1. Circulating solution before any additions of permanganate were made, though sand-filling had been rapid and continuous for there hours.
2. Overflow at dewatering cones, rate of sand discharge having been lessened and permanganate added until all solutions were strongly coloured.
3. Returned circuit water as used to flush sand from tip. Strong permanganate coloured solution.
4. Overflow of dewatering cones when sand filling had been resumed at full capacity. The permanganate was immediately destroyed on contact with sand.

In the above four samples the cyanide, as determined by evaporation with ammonium sulphide, was practically constant at 0.0015 per cent KCN—only showing a slight increase to 0.0017 per cent on the fourth sample.

The strong excess of permanganate in circuit, which existed when samples 2 and 3 were taken, was maintained for a considerable time before sampling to allow a maximum effect, if any, to be observed. Sample 3 is exactly the same solution as 2 but has retained permanganate during the time necessary to complete circulation. That additional length of time in contact did not result in any alteration of cyanide percentage, and it was still unaffected after one hour circulation.

When the present East Rand Proprietary Mines plant is working at a capacity of about 900 tons of sand per day, with a **circulating** solution of 20,000 gallons, it is not economically possible to maintain coloration by permanganate in the solution: it is, in fact, doubtful whether it is practically possible to colour it without extremely large additions of permanganate.

During the present tests a strong stream of fresh water was run through a box containing a large quantity of potassium permanganate crystals and the resulting solution went direct to the circulating water immediately after that water had overflowed from the cones. This gave a very strongly coloured circulating solution, but it was not even then possible to maintain the colour in full circuit, as it was immediately destroyed on contact with the sand at the tip. In this connection I might refer to Mr. A. F. Crosse's remark that "It is a very different problem, using an oxidising agent on a very dilute cyanide solution by itself to using the same agent in presence of sand containing pyrite, and in practice this would be the case." (**Journal** of this Society, Vol. XI., No. 1, 1910). Even were it economically possible to maintain the permanganate excess in entire circulating solutions it appears doubtful whether any real benefit would be obtained.

In a plant where the sand tip is from 50 to 100 yards from the dewatering cones, the sand is in the solution for only a very few minutes and very short contact results; the solution itself is constantly changing owing to the amount which is discharged with the sand (especially great when breakaways occur in the cones, owing to irregular sand feed)—and consequent make-up with fresh water to the circuit.

If the action of the cyanide were immediate, the brief contact would be adequate, but the action rather

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* Jour. Chem. Met. & Min. Soc. S. A.

Residence in Yucatan, Mexico.

Courtesy Mexico View Co.

Picking Coffee in Mexico.

Courtesy Mexico View Co.

On Their Way.

Courtesy Mexico View Co.

Drying Coffee, Vera Cruz, Mexico.

Courtesy Mexico View Co.

appears to be comparatively slow. Mr. White, in his comprehensive paper in June, 1910 (Vol. X., No. 2), and further remarks in November, 1913, does not appear to be perfectly clear on the point of time required for the various reactions—as witness the following quotations:—

" In practice, if permanganate be used, four hours contact must be given and the solutions leaving the vats must be distinctly red";

also:

" That completion of the reaction may take as long an hour in unfavorable cases";

and:

" That sulpho-cyanide destruction is complete at 15° C. **in a few hours.**"

In present practice the leached sand residue is tipped on to a grizzly and immediately washed away by the alkaline permanganate solution, which is decolorised, and the resulting pulp flows to dewatering cones, and thence direct to a borehole where a small amount of fresh water is added to facilitate flow in underground launders. The contact is very brief and dilution very great.

Sand residues carry about 12 per cent moisture—cone underflow 28 per cent, and the addition at borehole brings **total** water used to about 37 per cent—that is 60,000 gallons of water to 900 tons sand. The water carried in the cone underflow contains not more than 0.002 per cent KCN, and as this is further diluted, the actual amount of cyanide in drained sand in stopes is infinitely small. In no case does the sand receive permanganate treatment on the surface for more than a very small fraction of even the shortest time considered necessary by Mr. White.

To determine definitely, if possible, what time is necessary for decomposition of various cyanide compounds by permanganate, the following solutions were allowed to stand with permanganate and were tested at intervals:—

1. Normal solution from sand-filling plant containing 0.0013 per cent KCN and 0.0015 per cent KCNS.
2. Pure sodium cyanide—0.002 per cent KCN.
3. Pure sodium-sulpho-cyanide—0.002 per cent KCN.
4. Sodium-zinc-cyanide—0.002 per cent KCN.

The strength of these solutions was determined by the usual evaporation with ammonium sulphide and subsequent colorimetric test, and is expressed in terms of potassium cyanide.

Tests of the solutions with permanganate were made at 15 minute intervals for three hours—then at hour intervals, and later at longer intervals, for four days. The test used was by the hydrocoerulignone solution on filter paper which was placed inside the neck of a flask containing an acidified portion of the solution to be tested. The working solution, pure cyanide and sulpho-cyanide solutions were decomposed regularly and were obviously considerably affected by the permanganate, but nevertheless gave a test after four days, sufficiently positive to demonstrate that cyanide decomposition was incomplete and that the solution was still capable of evolving minute quantities of hydrocyanic acid in the presence of sulphuric acid; the working solution gave a distinctly stronger reaction than either of the other two. The sodium-zinc-cyanide reacted vigorously at all stages of the experiment, and appeared to be slightly—if at all—affected by the permanganate even after four days' contact. As a very large proportion of the cyanogen in working solutions appears to be in combination as the sodium zinc cyanide compound, the fact that this compound is extremely slowly decomposed by the permanganate is very important.

In the comprehensive paper on cyanicides, written by Dr. Moir and Mr. Jas. Gray, permanganate was apparently not deemed worthy of consideration, and though Mr. White discussed it at length, and appears to have been satisfied that ultimate decomposition of cyanides by permanganate is possible, he admited failures in treating working solutions, and attributed them to the fact that the tests were made on a cold day. Undoubtedly a certain amount of cyanide decomposition does take place, because generation of ammonia underground is obvious, and by gradual collection of the gas in poorly ventilated areas it becomes at times a nuisance; thus the delayed action of the cyanicide may be a double source of danger: firstly, because it may allow of evolution of hydrocyanic acid from the most recently filled areas, and, later, when a slight action has taken place, the formation of ammonia is troublesome.

In view of the high cost of most cyanicides and the difficulties of their practical economical application and chemical control, it is of interest to note that their object appears to be efficiently attained by purely natural means.

Recently occasion arose to drive a tunnel through a sand dump, and the opportunity was taken to test the air very carefully for hydrocyanic acid, as the ventilation was poor and the unwashed sand, of original high cyanide contents, had become very acid. It was not possible at any time to detect hydrocyanic acid in the air, but "Prussian blue" precipitate was abundant in the sand.

In sand-filling work the sand is sent underground a strongly alkaline solution which, on contact with mine water containing ferrous and ferric sulphates, precipitates ferrous and ferric hydroxides. The former is a very powerful cyanide absorbent—being used medicinally as cyanide antidote— and is quite capable of combining very rapidly with any free cyanide present. Samples of sand from stopes that have been filled for some time, and through which mine water has since percolated, show a considerably higher percentage content of iron than any original sand. A sample recently tested contained 7 per cent Fe, and thereby gave evidence of considerable iron precipitation in situ.

It appears that a high alkalinity in sand sent underground would solve the problem of safely disposing of cyanide in extremely dilute solutions. To determine exactly the condition of solutions actually delivered to, and drained from, an area being filled, two samples were taken underground and tested. The solution as delivered to the stope contained 0.0014 per cent KCNS and 0.0004 per cent KCN (cyanogen compounds other than sulpho-cyanides expressed as KCN) and was strongly alkaline,—the drainings from the same area at the same time contained traces of sulpho-cyanide, but **no other** cyanogen compound; they were neutral to methyl-orange indicator, and contained a considerable amount of ferrous-sulphate.

The scale in boilers is usually produced by the precipitation of calcium and magnesium salts from the water supplied. Their hardening to form scale is due to their becoming crystaline. Some boiler compounds are intended to form compounds with the calcium and magnesium which are not crystalline. Others are intended to act as a protective colloid and prevent the formation of scale by preventing the change of the deposit to a crystalline form. With such compounds the salts are thrown down as a sludge and are then easily blown off. The use of crude oil and other greasy materials to prevent scale are intended to form a film over the inside of the shell thus preventing the attachment of particles to the surface. There is almost as much quackery in the boiler-compound business as there is in the patent medicine industry.

Rutiles Deposits and Titanium.

Rutile, from which is derived the metal titanium, is a reddish, brownish, or nearly black mineral composed of titanium dioxide, and though it is widely spread through the rocks it is rarely found in large quantities. Titanium exists in larger quantity in the earth's crust than copper, lead, zinc, or any of the common metals except iron, but it is called one of the rare metals because of the lack of concentrated deposits and because the metal is so difficult to separate that it has been seen by few people.

The value of rutile arises from the use of titanium as a scavenger in molten steel and cast iron, and from the use of titanium salts in dyeing textiles and in tanning leather. The largest known deposits of rutile are at Roseland, Nelson County, Va. A few other much smaller deposits have been found in the eastern part of the United States, and still other deposits, also much smaller than those in Virginia, have been found in foreign countries.

Uses of Tungsten.

Tungsten in used principally as an alloy of high-speed steel—that is, steel used in making tools used in metal turning lathes running at high speed—to which it imparts the property of holding temper at higher temperature than carbon steels will, according to the United States Geological Survey. The now well-known ductile tungsten is used for incandescent lamps, which are fast displacing carbon lamps. Recently greatly improved lamps, in which the wire is wound in helices and in which the globes are filled with nitrogen, have produced a close approach to white light. These lamps are furnished in candle powers up to 2,000.

Ductile tungsten is practically insoluble in all the common acids; its melting points is higher than that of any other metal, its tensile strength exceeds that of iron and nickel, it is paramagnetic, it can be drawn to smaller sizes than any other metal (0.0002 inch in diameter), and its specific gravity is 70 per cent higher than that of lead.

Methane Indicators. — A new form of methane indicator for the detection of fire-damp in mines is described. It depends on the principle that differences in chemical composition of a gas are indicated by differences in the sound resulting when a pipe or whistle is blown by means of the gas. The apparatus is called the fire-damp whistle, and consists of a closed brass cylinder, 25 by 6 cm., containing 2 stopped pipes tuned to the same pitch when filled with the same gas. One pipe communicates with the outer atmosphere and the other with the air of the mine, freed from dust, CO_2, etc., by suitable apparatus within the cylinder. The apparatus is operated by pulling down the lower part of the cylinder, thus drawing in the air, the partial vacuum thus produced in one portion of the cylinder returning the piston and forcing the air through a pressure regulator to the mouthpieces of the pipes. With 1 per cent CH_4 content until near the explosion limit (about 5.5 per cent) a characteristic thrill results. The sound is perfectly audible in a mine at distances of over 100 metres. This indicator has given practical results and has advantages of safety not obtained by indicators depending on the presence of sparks, incandescent wires, etc. A sketch and detailed description are given.—F. Haber, Chem. Zeit.

The United States produces more radium that all the rest of the world put together. The output for the year ending September 1914 was about a half ounce of pure radium bromide salt.

Action of Sulphuric Acid on Copper. — The present investigation shows that cuprous sulphate rather than cupric sulphate, is one of the primary products, as may easily be tested by pouring off the sulphuric acid at any stage of the reaction through a Gooch filter into water, when a precipitate of finely divided copper is produced.—J. T. Cundall, Proc. Chem. Soc.

Estimation of Mercury.— Penfield's well-known method for determining water, especially in minerals, has been adapted for the determination of mercury in ores and minerals. In a piece of glass tubing 20 cm. long and 5 mm. wide, two bulbs are blown, one at the closed end and another near the open end. A small quantity of the powdered sample mixed with lime is filled into the clean, dry tube through a drawn-out glass funnel. The tube is then filled up to a depth of 8 cm. with iron filings and quicklime. An asbestos plug is pushed in midway between the bulbs, and the open end of the tube drawn out to a fine capillary. The end bulb, with its charge, is heated at first inside an iron pipe, finally in the flame itself, the mercury being driven out and condensed in the second bulb, which is kept cooled. This bulb, with the mercury, is then drawn off, the moisture present is removed by a current of dry air, and the bulb and its contents weighed. The mercury is then run out and completely removed by drawing a current of air through the hot tube. Finally the empty tube is weighed. If sulphides are present lead chromate should be added to the mixture before heating.—Cumming and Macleod, Journal Chem. Soc.

Electro-Deposition of Zinc.— At certain very high current densities the electro deposition of zinc can be effected in presence of a high concentration of free acid. Under these conditions the ratio of zinc to hydrogen liberated actually increases with the acid concentration up to a certain value, and also increases with the current density. In this way, with a concentration of sulphuric acid of about 15 gms. per 100 cc. and a current density of between 20 and 50 amps. per sq. dcm. the metal can be deposited with an efficiency of about 95 per cent.

With lead anodes this electrolysis is achieved with a potential difference about 5 volts and with zinc anodes 3 volts.

The presence of small quantities of colloidal matter exerts a marked effect on this reaction, and enables the production of bright, adherent deposits. The presence of the colloid also enables the application of a higher current density, and in this way raises the current efficiency.

In these solutions a very strong retardation was observed in the deposition of iron present in the electrolyte. On account of this, considerable quantities of this metal in the electrolyte caused very little contamination of the zinc.

The results obtained could not be entirely ascribed to effects of over-voltage, or surface tension, or viscosity of the electrolyte, and are probably mainly determined by influences which control the rate of the reactions involved in the change from the ionised to the free element.

The results obtained in this work indicate the most favourable conditions under which zinc can be obtained from commercial solutions, either with a view to the recovery of the metal or to its application for the purpose of electro-plating.—J. Norman Pring and Urlyn Clifton Tainton.—Proc. Chem. Soc.

Viga Canal, Mexico City.

PERSONALS.

H. F. Grondijs, of Oruro, Bolivia, is in New York.

Sven G. Cajander, mechanical engineer, is with the Braden Copper Co., Rancagua, Chile.

Wm. H. Shelby is with the Moctezuma Copper Co., Pilares de Nacozari, Son.

James Watts is chief mine agent for the St. John del Rey Mining Co., Villa Nova de Lima, Minas, Brazil.

Lester E. Grant is assitant to the general manager of the Braden Copper Co., Roncagua, Chile.

Alfred L. Johns, formerly at the Cinco Minas in Jalisco, is mining engineer for the Marcus Daly Estate, New York.

Robt. W. Mackey is chief engineer for the Cía. Estanifera de Llallagua in Bolivia.

Robt. H. Townsend is manager of the San Luis Mining Co., San Dimas, Dgo.

John L. Church is superintendent of the San Toy Mining Co., Santa Eulalia, Chih.

Charles Fowles is at San Lucas de Ocampo, Dgo.

Walker B. Longan is with the New York & Honduras Rosario Mining Co., San Juancito, Honduras.

Jesse C. Porter is with the Mines de Matahambre, Cabezas, Pinar del Río, Cuba.

R. W. Whitesides, mining engineer of Douglas, Ariz., examined mining properties in northern Sonora recently.

C. J. Schultz is general superintendent of the Moctezuma Copper Co., in Sonora.

Roy Burleigh is with the La Luz y Los Angeles Co., Zelaya, Nicaragua.

C. M. Gregg is with the Ajuchitlan Mining & Milling Co., at Tequisquiapan, Qro.

J. H. Broidrick is superintendent of the Guerrero Mill of the Real del Monte Co., at Real del Monte, Hgo.

Félix Cremer has returned to Needles, Calif.

J. D. Bowen is at Fort Collins, Colo.

H. G. Bretherton has returned to Aguascalientes from the States.

J. V. Kelly is now with the Real del Monte company at the Guerrero Mill. Real del Monte, Hgo.

Eugenio Leroy is with the Neg. Minera Angustias y Dolores, at Pozos, Gto.

Robert Allen is with the Cam & Motor Mines at Eiffel Flats, Rhodesia.

H. S. Denny expects to leave London for Mexico and arrive here this month.

Harold A. Lewis has been appointed manager for the Porto Tin Mines, Ltd., in Bolivia.

Francis J. Hobson, formerly of Zacatecas, has an assay office in Nogales. Ariz.

Otto Larson is night foreman at the Cerro de Plata company's mill, Imuris, Son.

John Glasson, formerly superintendent of the Richfield Copper Co., is mine superintendent of the Bradford mine, Patagonia, Ariz.

Frank Lawrence has returned to San Antonio, Baja California.

L. K. Fletcher is at Santa Rosalía, Chih.

A. C. Sávage was in El Paso, Texas, superintending a shipment of cyanide for the Esperanza Company of El Oro.

Oliver Powers is now with the Creston-Colorada company at Torres, Son.

L. G. Truehart is at Parral, Chih.

A. W. Hahn is engaged in research work at the Santa Gertrudis, Pachuca.

W. H. Yeandle is examining property in the State of Morelos.

R. M. Raymond has returned from a trip to Chihuahua and El Paso.

Geo. Hinton, superintendent of the Rincon Mining Co., has returned to the property at Temascaltepec, Mexico, and is preparing to resume operations.

W. Howard of the Amparo Mining Co., Jalisco, has gone to El Paso looking up supplies.

F. K. Boyd is developing a plant for the electrolytic separation of metallic lead and tin.

C. W. Van Law, manager of the Real del Monte Co., has returned to the property a Pachuca.

Spencer N. Cook, of the Fresnillo company, is in Ohio.

Claude J. Pinson, formerly mine superintendent at Santa Rosa, Zac., is with the Buena Tierra company at Santa Eulalia.

Victor M. Braschi and T. E. Pratt last month visited the new mill of the Cia. Minera La Lucha y Anexas, Tlalpujahua, Mich.

George Noble has gone to El Paso, Texas, from Durango.

F. K. Boyd has taken a position with the Dos Estrellas company at El Oro.

C. Q. Schlereth, now located in Denver, Colo. and formerly of Mexico, has been in New York.

Chas. F. Spaulding, formerly engaged in mining engineering and metallurgy in Mexico, will open an office in Salt Lake City.

Lawrence A. Brasher is with the American Trona Corporation at Trona, Calif., U. S. A.

H. W. Fowler has returned to the Chontalpan property at Temascaltepec after a visit to Mexico City.

José Teja is with the Neg. Minera y Ben. El Coloso y Anexas, at Pozos, Gto.

A. L. Flagg, formerly of Durango, is manager of the Kelvin-Sultana Copper Co., Kelvin, Ariz.

E. A. Strout is manager of La Fe Mining Co., Guadalupe, Zac.

Schuyler Lawrence has leased the San Antonio mine of the A. S. & R. Co., at Santa Eulalia, Chih., and is shipping ore to the smelters.

END OF THE TRAIL.

W. E. Clark, manager of the Mexican Steel Products & Machinery Co., of Mexico City, with offices in the Mutual Bldg., died suddenly at San Antonio last month. Mr. Clark left Mexico early in November apparently in the best of health. Mr. Clark had been active in iron and steel construction work in Mexico for some years, some of his later operations having been the erection of tanks and structural steel at the Cinco Minas and La Fe mills.

PATIO

The method, developed at the Tooele plant of the Anaconda Copper Co. for converting matte containing lead, consists in overblowing in the absence of silica in basic lined converters. The old method of adding to the molten matte sufficient siliceous material to produce a standard slag produces a fume which is very corrosive in the bag-house. Blowing without silica was expected to build up a magnetite crust inside the converter lining, but this has proved not to be the case. The basic slag is relatively rich in copper but this is recovered by retreatment to which all converter slags are subjected in any case.

Experiments in the hydrometallurgy of copper, which have been very numerous lately, have been largely directed to methods of precipitation from solutions. Precipitation of the copper by means of metallic iron have been especially under investigation. Electrolysis produces a clean product, but in many cases difficulties due to foul solutions have to be overcome. The precipitate by metallic iron is impure, but this is of little consequence when the leaching plant in run in connection or near a smelting plant. Sponge-iron, produced from iron ore at a low temperature is now used to replace scrap iron which in large plants is not often available in sufficient quantity. Some of the leading metallurgists believe that the development of copper leaching has about reached its limit, and that the losses in concentrating will be recovered by flotation processes with subsequent smelting.

Flotation as a means of separting minerals from ores has been greatly improved during the past year, but many of the more important developments have been kept secret. It is now known that a selective concentration between sulphide minerals is possible, but the exact conditions required have not yet been worked out.

Fluor spar has long been used for making slags more fluid. It is commonly employed in small quantities, so small that the mere fusibility of the mineral itself does not explain its action. Chemically, by adding lime and removing silica, fluorspar should make a slag more basic. Yet in small quantities it is extremelly effective in making basic slags more fluid. It has lately been suggested that the action of this flux is to be regarded as being in the nature of a catalytic agent rather than as a direct flux.

In the conversion of an old leaching plant in Nevada into a continuous slime settling plant, low tanks only 5 ft. high are being converted into Dorr thickeners. As the tanks are on the same level it is impossible to secure gravity flow. The discharge from the thickeners will, therefore, be run into mixing cones and the resulting pulp elevated by means of air lifts the flow being regulated by floats in the mixing cones.

The process used by the Roessler & Hasslacher Co. at its Perth Amboy plant for the manufacture of sodium cyanide is the synthetic process invented by Hamilton Y. Caster, an American chemist. The raw materials are metallic sodium, carbon and ammonia. In a recent statement made by Otto Ruhl, a member of the firm, he said: "It took fully ten years to reach the high standard of sodium cyanide which we are now producing, equivalent to 128 and 130 per cent of potassium cyanide, now universally recognized as the only proper material for electroplating, fumigation and gold extraction purposes."

Many mines are now idle which would pay under careful and skilful management, says Ira F. Monell of Boulder, Colo. If we could systematize our mills better, cut out the idea of "foolproof" machinery and employ at at premium a few interested, skilled and studious men who will work not only for salary, but for success; cut out the idea of a big tonnage as the first essential (especially where it is impossible to get it with existing capacity of mine and mill) and hold to the idea of close saving of mineral values and economy in all lines, we should have less idle mines, less decaying mills, monuments of failure and loss.

The lining of firebrick in the great blast-furnaces used in the production of pig iron are constructed extremely thick to withstand the abrasive action of the charge during long campaigns lasting sometimes for several years. These heavy sals are in the course of time cut so law to change materially the inner lines of the furnace. In recent years there have been several attempts to preserve the lines of the furnace by building the walls thin and applying water-cooling to the outer shell. This practice has met with a measure of success, but there is now a tendency to return to the older practice, for it has been found that with extensive water-cooling the furnace becomes very sensitive to the temperature and the amount of water employed, and it is also recognized that the furnace does its best work when it is allowed to make and vary its own interior lines.

In setting firebrick in furnaces wide joints indicate bad work. Some metallurgists go so far as to insist that all unevenness must be removed by chipping each individual brick where any appreciable warpage exists, making what is known as a "case-knife-job".If the binding clay is the same material as went into the manufacture of the bricks such extreme precautions hardly justify the greatly increased expense. Careless work should not be tolerated and all the joints should be properly flushed, in which case the wall will burn solid. Making the fireclay too thin may easily be overdone. If the clay is very thin when the bricks are set in place with a mallet and there is any warpage the bricks spring enough to throw the fireclay out of the joint. When the fireclay is made so thick that it will just pour from a dipper it is too plastic to permit this action and the joints remain properly filled.

The stamps or rolls controversy is in force in the mills of the Cobalt district, Canada, with the advantage in favor of stamps, for 80 per cent. of the ore is crushed in batteries. One reason for this is that tube mills are little used, because the release of the values does not require fine grinding. It is the practice, therefor, to crush in one stage with stamps alone. The stamp men claim that rolls do not work well on the tough conglomerate, but it also seems to be true that heavy rolls have not been used.

The cost per ton of ore of the wet desulphurization process recently installed in the Nipissing mill is for aluminum in ingots and sheets, 28 cents and for caustic soda, 7 cents. This calculation is based on the treatment of 77,240 tons of ore. The recovery of silver during this period was 91-85 per cent.

The use of a microscope or, if that is not available, a good pocket lens may be of great help in concentration. The frequent use of the pocket magnifier will keep the millman posted on many things. It will show him how clean are his tailings from attached mineral particles and also whether the liberated mineral is properly saved. A buckboard, set of screens and a pan for frequent grinding and pan tests should be at hand. The work done by the concentrators is as worthy of intelligent interest as smooth running of shafts, belting and bearings.

CONCENTRATES.

From Mexican Mining Camps.

Baja California.

There has been comparatively little trouble through revolutionary causes in Baja California and practically all mining is going ahead as usual. The large mines at Santa Rosalía are in continuous operation as are others in the various mining districts of the state.

Chihuahua.

Parral.—Reports from Parral are that conditions there are better than they have been at any time during the past four years.

Alvarado.—This property at Parral is in operation and the management expects to have power from the Boquillos plant by next April.

Encinillas.—This plant at Santa Rosalía, sometimes called the Camargo smelter, started up Jan. 20 under a new company, La Independiente, S. A. The ore will come mainly from Naica and the Cigarrera mine. Mr. Broniman, of Santa Rosalía, is manager. W. H. Seamon, formerly of Chihuahua, is metallurgist and L. A. Fletcher, assayer.

Boquillas Dam.—Work on this enterprise on the Conchos river is about completed and would be prepared to deliver power if it were not for the difficulty of securing supplies. The plant is expected to deliver from 30,000 to 10,000 h. p. Santa Eulalia and Parral are to be supplied with power and a line is to be run into the city of Chihuahua. Later on a line will also be run into Guanaceví, Dgo.

El Cristo.—Work is going ahead at this property in the Santa Eulalia camp and ore shipments made to the Chihuahua smelter.

Cusi Cons.—Development work is in progress at this mine in the Cusihuiriachic district.

Cusi Mining Co.—The property is working and shipments are being made to the Chihuahua smelter.

El Rayo.—This property at Santa Bárbara is in operation.

Batopilas.—Both mills of the Batopilas company are running at about two-thirds capacity, and will be increased to the maximum as soon as possible

Santa Eulalia.—The mines in this district are producing almost a normal tonnage, making daily shipments to the Chihuahua smelter.

Coahuila.

Sierra Mojada.—There is a considerable amount of mining being done in this district and shipments are being made regularly to the Chihuahua smelter.

Durango.

The Velardeña mines are working and shipping continuously to the smelter of the A. S. & R. Co., at Asarco.

Guanajuato.

All of the principal mines and mills at Guanajuato are in continuous operation. The Carmen mill, which was shut down during July, August and September has been in operation since that time. The Bustos mill and the Flores cyanide plant have been operated continuously as has been the mill of the Consolidated company. Mining and milling in the Pozos district has been carried on with little interruption. The mill of the Cia. Beneficiadora de Pozos has been in continuous operation since its construction.

Jalisco.

El Favor.—The new electric power plant and transmission system of the El Favor Mining Co. has been completed to furnish power enough to run a 500-ton mill. The property has not been in operation since last April but has not been damaged physically and is ready for resumption at short notice. Operations are expected to be resumed shortly. Meanwhile experiments are under way at Basin, Mont., on the treatment of El Favor ores by the Field process. Early experimental trials indicate that recoveries of over 90 per cent are possible by the Field process.

Cinco Minas.—This property has been operating steadily without interruption and, as usual, have had splendid recoveries from its ores.

Amparo.—This property in the Etzatlán district has continued in steady operation with the usual good results. The company has sent 134 bars of bullion and 26 tons of concentrates to the San Francisco smelters and received $128,601 for the shipment.

Sonora.

La Cobriza.—Active operations have been resumed at this big copper property and shipments of copper matte will be made to the Douglas smelter. Roy J. Mitchell is manager.

Creston-Colorado.— The plant of the Mines Company of America has been damaged by rains which recently flooded southwestern United States and norther Mexico. The extent of the damage has not yet been ascertained.

Cumpas.—Although the recent heavy floods in this section caused considerable demage and loss of life mining operations have not been interfered with to any extent and shipments of ore to the smelters at Douglas have not been interruped.

Cerro de Plata.—Work at this property is going along smoothly under the management of Walter Holt.

La Cobriza.—Manager Mitchell is arranging to make big improvements and additions to the plant at La Cobriza during the present year. Just as soon as conditions will warrant he will commence the installation of a big converter and compressor, which have been ordered and will be shipped in the near future. The big copper camp at La Cobriza will soon be in full operation.

Despite the revolution the mineral output of the state of Sonora during 1913 and the first half of 1914 was the highest in the history of the state, especially in north Sonora. The complete returns of Sonora's mineral production for 1914 are not yet available. Preliminary estimates place the figure at $20,000,000 to $21,000,000, as against $24,815,000 in 1913. During the second half of 1914 Green-Cananea, one of the principal producers in Sonora, was forced to shut down owing to a labor strike, followed by fires and then by the war in Europe, which hit very hard the entire copper industry of the world. The European war and copper situation also caused a big curtailment at the big Nacozari plant of the Moctezuma Copper Co., which has been on a 75 per cent production basis since August. The output of El Tigre and of the Mines Company of America in 1914 will subsctantially exceed their production of 1913.

El Tigre.—This company is operating steadily at capacity and during the past year paid out in dividends $715,337 gold. The total dividends paid to date since 1908 aggregate $2,769,809 U. S. Cy. Net profits of from $70,000 to $75,000 a month are being made. The mine is in excellent condition and a full force of men is employed. Three parallel veins have been opened up in the property by tunnels, making mining costs very low. It is stated that the reserves of actual and possible ore are sufficient to maintain the present output of the mine for approximately six years.

North Tigre.—A 50-ton mill has just been completed on the North Tigre mine, adjoining El Tigre mine on the north and under lease to the United Mines Co. Power is purchased from El Tigre company.

Central America.

Nicaragua.

Panamá Mining Co.—A large force of miners are employed in the development of the property under the direction of Louis Garbrecht of the Tonopah Mining Co.

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ASK FOR CATALOGUE.

The Eden vein is being opened up by two crosscut tunnels through country rock to tap the vein and one tunnel driven on the vein. This latter tunnel was driven by Mr. Irvin personally for 100 ft. The average assay value of all material for the full width and length of this vein, five to seven feet, was over $40 per ton in gold. This vein is now being opened up by the Tonopah people by a tunnel 600 feet below the outcrop. They have cut the vein in this tunnel and the vein is wider at this depth. The other important veins are the Nugget, proven for about 1,500 feet, 18 to 20 feet wide, $9 to $14 value. The Hidden Treasure vein is 1,800 feet long. This ore body has been developed for 900 feet by crosscuts, shows average width of 20 feet, values $15 per ton in gold. The Claudia vein is proven by open cuts for 1,800 feet, average width 12 feet, values $7 to $8. This vein crosses the rich Nugget vein at the top of a hill over 1,400 feet high. The Comal vein is one of the biggest veins opened up in Nicaragua, and is from 20 to 60 feet wide. It has numerous cuts for full width of vein and is crosscut at depth by No. 3 tunnel on the Eden vein. This deposit shows $5 to $6 average value and can be very cheaply mined and shows a large profit. In addition to the veins spoken of, the Tonopah people have opened up numerous other veins. The whole property is a network of gold veins and needs only the expert treatment and large investment which the Tonopah men are now giving it.

Javoli & Escandalo Mining Co.—The company intends installing a 150-ton cyanide plant and general manager Ignatius O'Reardon was in New York recently purchasing the necessary machinery. The property is located in La Libertad district.

South America.

BRAZIL

Alagoas.—A discovery of petroleum in this district is reported. The fields are said to extend over 250 square miles, and the oil is reported to be of good quality.

VENEZUELA

Mining Concessions.—A decree has been issued by the government providing that no concession granted by the executive shall be valid until it has been approved by Congress, and work must be postponed until that approval has been obtained.

New Publications.

Graphical Determination of Sags and Stresses for Overhead Line Construction, by Guido and Marco Semenza. transladated from the Italian by C. O. Mailloux, 24 pages, 13 charts, 9 by 12, $5.00 net, McGraw-Hill Book Co., New York.

The Preservation of Structural Timber, by Howard F. Weiss, Director, Forest Products Laboratory, U. S. Forest Service, 312 pages, illustrated, 6 by 9, $3.00 net, McGraw-Hill Booc Co., New York.

The Cementation of Iron and Steel, by Dr. Federico Giolotti; translated from the Italian by Joseph W. Richards, Ph. D; 407 pages, 155 illustrations, 6 by 9, $4.00 net. McGraw-Hill Book Co., New York.

Annual Report of the Director of the Mint for the Fiscal Year ended June 30, 1914, Also the Production of Precious Metals in the Calendar Year 1913; 291 pages, illustrated; Treasury Department, Washington, D. C.

Notes on the Sampling and Analysis of Coal, by Arno C. Fieldner; Technical Paper No. 76; 61 pages, illustrated; U. S. Bureau of Mines, Washington, D. C.

Contributions to Economic Geology, 1912, Part II—Mineral Fuels; by Marius R. Campbell and others; 541 pages, illustrated; Bulletin, U. S. Geological Survey, Washington, D. C.

Some Benefits of Safety First in Mining; by James W. Paul; Paper presented at a meeting of the Kentucky Mining Institute, 15 pages.

The Source, Manufacture and Use of Lime; by Ernest F. Burchard and Warren E. Emley; 85 pages, illustrated with map; advance chapter of Mineral Resources of the United States, 1913; U. S. Geological Survey, Washington, D. C.

Analysis of Coal with Phenol as a Solvent, By S. W. Parr and H. F. Hadley; 41 pages, illustrated; Bulletin 76, University of Illinois Publications. University of Illinois, Urbana, Ill.

Petroleum Yearbook; 1914, compiled by Sydney H. North; 104 pages, index; $2.00 net; Wilkinson Bros. Ltd. London.

Assaying in Theory and Practice, by E. A. Wraight; 323 pages, illustrated; $3.00; Longmans, Green & Co., New York.

Fourth Annual Report of the Director of the Bureau of Mines, for the Fiscal Year ended June 30, 1914, by Joseph A. Holmes; 101 pages; Government Printing Office, Washington, D. C.

Metal-Mine Accidents in the United States during the Calendar Year 1913, By. Albert H. Fay; Technical Paper 84, U. S. Bureau of Mines, Washington, D. C.

Crystallography: An Outline of the Geometrical Properties of Crystals, by T. L. Walker. 204 pages, illustrated, $2.00. McGraw-Hill Book Co.

Report of the Director of the United States Bureau of Mines for the Fiscal Year Ended June 30, 1914. By Joseph A. Holmes. Department of the Interior, Washington, D. C. 101 pages.

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METAL MARKET.

The metal markets are still under the depressing influence of the European war. A gradual recovery has been noted in nearly all lines except silver and tin. Increased activity in steel shows that business outside of the countries actually at war is inclined to go ahead instead of waiting for a final settlement.

Copper has still lacked the extensive sales necessary to the restoration of confidence, but prices have recovered partly due to an advance in London and partly to increased interest among the brass men in the United States. Early in the month sales were made at 13 cents which figure soon after rose to 13½ cents, and producers were confident that they would soon be able to sell at this rate on regular terms. Walker, the Boston copper market expert, is extremely optimistic as to the outlook for this metal, estimating that prices will rise to 20 cents immediately after the cessation of hostilities, and that it will take at least six months for production, which has been reduced to half the normal capacity, to reach its unual tonnage.

In spelter a rather brisk business developed, mostly in the United States but also for export to Europe. Prices rose sharply in consequence. Considerable sales were made early in the month, some lots of 500 tons being noted.

In lead only a small business is reported and prices remained unchanged.

Very little interest was shown in tin, statistical reports being decidedly unfavorable. Even in view of a temporary rise in London, sales on this side the Atlantic almost disappeared.

Silver has as yet shown only minor signs of recovery. The expected buying in China has not developed and sales have been light. Large stocks of bullion have been stored awaiting the rise expected when peace is declared.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59 207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58.175	28.038	27.825	26.704
June	61.290	58.990	58.471	28.215	27.199	26 948
July	60.654	58.721	54.678	27.919	27.074	25.219
August	61.606	59.293	54.344	28.375	27.335	25.979
September	63.078	60.640	53 290	29.088	27.986	24.260
October	63.471	80.793	50.854	29.299	28.083	23.198
November	62.792	58.995	49.082	29.012	27.263	22.703
December	63.365	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14 971	14.491	15.253	14.946	65.519	65.259
March	14 713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14.672	61.603	14.871	.....	67.140	66.274
July	14.190	13.223	14.563	.....	84.166	64.955
August	15.400	.....	15.904	.....	69.200	53.227
September	16.328	.....	18.799	.....	73.125	.....
October	16.337	.....	18.913	....	73.383	.....
November	15.182	11.739	16.022	....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1913	1914	1913	1914
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.555
March	46.832	38.038	213.615	173.819
April	49.115	36.154	224.159	163 963
May	49.038	33.360	224.143	150 702
June	44.820	30 577	207.208	138.321
July	40.260	31.707	183.511	142.517
August	41.582	...	188.731	... .
September	42.410	32. 875	193.074	.....
October	40.462	30.284	184.837	.....
November	39.810	33.304	180.869	139.391
December	37.035	.....	171.786	.....
Av. year	44.252	.....	206.279	....

New York in cents per pound; London in pound sterling per long ton.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.850	15.977	19.651
April	4.381	3.810	4.242	3.683	17.597	18 225
May	4.342	3 900	4.226	3.863	18.923	18 503
June	4.325	3.900	4.190	3.810	20.226	19.411
July	4.353	3.891	4 223	3.738	20.038	19 051
August	4.624	3 875	4.550	3.715	20.406	
September	4.698	3 828	4.579	3.658	20.648	
October	4.402	3.528	4.253	3 384	20.302	
November	4.293	3.683	4.148	3.565	19.334	18.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	6.931	5.262	6.854	5.112	26.114	21.583
February	6.239	5.377	6.089	5.227	25.338	21.413
March	6.078	5.220	5.926	5.100	24.605	21.460
April	5.641	5.113	5.491	4.963	27.313	21.569
May	5.406	5.074	5.256	4.924	24.583	21.393
June	5.124	5.000	4.974	4.850	22.143	21.345
July	5.278	4.920	5.128	4.770	20.592	21.568
August	5.658	5.568	5.508	5.418	20.706	
September	5.694	5.380	5.444	4.230	21.148	
October	5.340	4 909	5.188	4.750	20.814	
November	5.229	5.112	5.083	4.962	20.581	25.016
December	5.156		.004		21.214	
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

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TRADE NOTES

Allis-Chalmers Co., Milwaukee, Wis., has issued a catalogue of ore milling machinery printed in Spanish for the convenience of users of this class of machinery in Mexico, South and Central America. It includes Jaw and gyratory crushers, sample pulverizers, bucket elevators and belt conveyors, revolving screens, automatic samplers, stamp mills, crushing rolls, Chilean and Huntington mills, classifiiers, vanners and concentrating tables, jigs, tube mills, equipment for cyanide mills, electrical machinery, steam and gas engines, etc. In the back part of the catalog are conversion tables and several pages of other useful information.

Maquinaria y Aparatos para la Reducción de Piedras y Minerales, Fabricación de Cemento y Fundición.--Power & Mining Machinery Co., Milwaukee, Wis. In this catalog, published in Spanish, is presented a line of stone and ore-crushing machinery, elevating machinery, machinery for the manufacture of Portland Cement, copper converters, blast furnaces, internal-combustion engines, gas producers, etc. The crushing aparatus includes McCull gyratory crushers, crushing rolls, jaw crushers, Chilean and Huntington mills. The cement machinery shown includes rotary furnaces, ball mills, tube mills.

The Directory of Piston Ring Sizes, is the name of a publication issued by the Burd High Compression Ring Co., Rockford, Ill. It gives sizes and dimensions for all sizes of engines and compressors, the rings being fitted with a coupling making the piston ring continuous and eliminating the usual gap.

The January, 1915, Reminder, issued by the Robins Conveying Belt Co., New York, contains besides the usual convenient monthly calendar and note book, illustrations of conveyor belts in coke-handling and by-product plants: also a rotary grizzly which should be of interests to mining men.

The Pierce Amalgamator Co., of Denver, Colo., reports the sale of one of his amalgamators to George A. Blaisdell, at Barranquilla, Colombia.

The Bristol Co., Waterbury, Conn., manufacturers of gagues and instruments for recording pressures, liquid levels, temperatures, mechanical motions, etc., is installing in a number of plants equipment for recording at a distance. These recording gagues may be placed in the central office miles away from the machine whose work they record.

The Western Electric Co., St. Louis, Mo., has issued a bulletin on switchboards, published in Spanish, for distribution in Mexico and Spanish-America.

The Watt Mining Car Co., Barnsville, Ohio, has issued a description of its wheels and cars of various types in a recent catalogue. The catalogue is illustrated and contains information of different kinds.

The Denver Fire Clay Co. has issued a bulletin describing the Case oil-fired assay furnace. This bulletin, No. 50, is ready for distribution and gives a number of views of these furnaces recently installed at the property of the Consolidated Smelting & Mining Co. of Canada.

The Lunkenheimer Co. is distributing two booklets devoted to "Ferrenewo" and "Clip" valves.. The "Ferrenewo" valve is made in globe, angle and cross pattern, all parts being replaceable. The "Clip" valve of the gate type has been manufactured by the company for a number of years.

The Ingersoll-Rand Co. has recently put upon the market a portable air compressor mounted upon a four-wheel truck and driven by a gasoline engine. The capacity is 45 cu. ft. of air per minute at a pressure of 90 lb. The compressor cylinder is direct connected to the single cylinder gasoline engine, both pistons working on the same crank-shaft. The engine is of the single-acting, two-cycle type. Cooling is provided for by a gear-driven pump and an automobile radiator serving both engine and compressor.

The Merrill Metallurgical Co. will be represented at the Panama-Pacific exposition to be held at San Francisco by a working plant to demonstrate the efficiency of the company's machinery. From a platform the various operations may be seen including classification, agitation, clarification, precipitation and filtration. The exhibit will adjoin that of the Bureau of Mines.

The Lane & Bodley Co., Cincinnati, O. in a new catalogue, Form 28, illustrates and describes Heavy-Duty and Columbian Corliss Engines.

The Chicago Pneumatic Tool Co. in Bulletin No. 34-K gives illustrated descriptions of stationary and portable tank-mounted single tandem fuel-oil compressors.

The Lagonda Manufacturing Co., Springfield, O. manufacturers of boiler tube cleaners and scale removing apparatus is distributing a new bulletin descriptive of the firm's products.

The Wedge Mechanical Furnace Co., Philadelphia., Pa. solicits analyses of ores, concentrates or material to be roasted, characteristics and physical condition with tonnage required in 24 hrs. for calculation of the best type and unit of roaster to be supplied.

A rope supplied by the Broderick & Bascom Rope Co., St. Louis, Mo. 4,800 ft. long and 1½ in. in diameter pulls a skip which is believed to be the largest in the world. The capacity is 10 tons from a depth of 3300 ft. The rope is of the Yellow Strand Brand.

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La Mica.- Sus Usos, Lugares y Cantidad de Producción.

La mica se encuentra en abundancia y gran distribución en las rocas de la superficie, bien en granos pequeños o en láminas, formando parte integrante de varias clases de piedras, o en cristales más grandes, en rocas de determinada clase. En este artículo sólo trataremos de la distribución de los depósitos que contienen mica en cristales lo suficientemente grandes para hacer ganancioso su explotación.

Al presente, los principales países productores de mica son la India, Estados Unidos, Canadá, Africa Oriental, Alemania y el Brasil. Producciones en escala menor se tienen también en Africa del Sur, Ceilán, Noruega, China, Japón, Argentina y Australia del Sur. Depósitos de un valor probable, se fijan en Nueva Zelandia, Australia Poniente, y en las Islas Filipinas.

En este país la mica se explota en varios Estados, de los cuales sólo unos cuantos son productores constantes. El Estado de Carolina del Norte ha ido por muchos años a la cabeza como productor de mica, y la producción de los siguientes Estados ha variado de importancia: Nueva Hampshire, Dakota del Sur, Idaho, Nuevo México, Colorado, Virginia, Carolina del Sur, Alabama y Georgia. Pequeñas explotaciones de depósitos que parece que serán de valor en el futuro, están situados en Wyóming, Utaha, Arizona, California, Washington, Maine, Connécticut, Nueva York, Pennsylvania y Máryland.

Los más de los depósitos de mica en los Estados Unidos se encuentran en regiones de roca metamórfica en alto grado, tales como mica, granate, cianita, fibrolita, estaurolita, hornablenda, y gneises y esquistos de granito menos alterados o en rocas ígneas. Los gneises y esquistos altamente metamórficos se consideran que sean de la edad pre-Cambriana en los más de los puntos donde se encuentran; en otros, la edad no se ha determinado.

Los depósitos de mica moscovita con valor comercial, se confinan a la roca pegmatita. Esta roca varía un tanto en composición, pero en su estado que muestra mayor uniformidad se compone de feldespato y cuarzo con o sin mica y otros minerales. Se encuentra, por consiguiente, relacionada en composición al granito, y ha sido llamada "granito gigante." La estructura varía de la del granito común, a las masas en las que los granos o metales individuales miden varios pies de espesor, y estas variaciones pueden encontrarse en el mismo depósito.

Las variedades de feldespato encontradas con más frecuencia en la pegmatita, son el feldespato de potasa y el de esta base, pero del sistema triclínico. En muchos lugares, sin embargo, una especié de feldespato triclínico, bien el albita o el feldespato sódico calizo, compone parte, si no todo el cuerpo de este elemento. El feldespato se encuentra en masas y cristales imperfectos, algunos de los cuales bien pueden ser varios pies de espesor.

El cuarzo se presenta en la pegmatita en varias formas, bien entrelazado con el feldespato y la mica en la estructura del granito, formándose junto con el feldespato de modo gráfico, o haciendo masas grandes y separadas. En el último caso, el cuarzo puede formar hojas o venas en el interior, o a lo largo de las paredes, o puede aparecer en cuerpos de forma regular por entre la pegmatita. En estas segregaciones, se observa que el cuarzo forma masas de estructura granular, aunque en ciertas localidades se ven también cristales de tosca formación.

La mica se encuentra en la pegmatita en varias posiciones, y no hay una regla cierta que se pueda asentar para descubrirla en los varios depósitos. En estas pegmatitas, en las que las segregaciones de cuarzo son prominentes, la mica es generalmente más rica cuando está inmediata al cuarzo. En algunos depósitos, se encuentra a la mica que sigue una a la otra pared del cuerpo mineral y en otros bien podrá encontrársele distribuida por entre la pegmatita de modo uniforme o variado. Los bloques o cristales de mica son generalmente imperfectos y en tamaño varían desde una fracción de pulgada hasta tener varios pies de espesor.

La pegmatita se halla en masas irregulares, en hojas, en cuerpos cóncavos simétricos, pilas o chimeneas, todo lo cual varía en volumen, desde el depósito pequeño hasta el que mide muchas yardas en espesor y largo. Estas masas minerales cortan a la roca que las encierra en varias maneras, bien conformándose con el asiento de aquélla, o inclinadas a cierto número de grados.

De nuevo, algunas pegmatitas forman ramas; esto es, se separan de un cuerpo principal a formar dos o más hojas. Entradas de la roca adyacente son muy frecuentes, descansando en hojas paralelas a las paredes de la pegmatita, o las entradas pueden ser de masas no iguales en forma, y ocupando posiciones distintas por entre el cuerpo de la pegmatita.

La Extracción y Beneficio de la Mica

El encontrarse la mica en depósitos de naturaleza tan irregular, como quedan descritos, hace que su explotación sea problemática. En algunos cuantos de los depósitos, la pegmatita está en capas, poco torcidas relativamente, que se extienden por más o menos alguna distancia. Si la parte de mica no es muy variable, pueden aplicarse entonces los métodos usuales de minería; esto es, la apertura de pozos, túneles, socavones y obras de escalón y otras de la clase, serán irregulares. Tales depósitos nos llevan de "accidente" o sin plan definido. Si se halla la pegmatita en grandes masas, con bastante mica que permita la explotación, entonces el mejor método de trabajar la propiedad es el que se sigue en las canterías.

Al trabajar la mina debe de cuidarse de no hacer perforaciones por entre buenos cristales de mica. Los mineros que usan los taladros de mano o de fuerza motriz, pueden generalmente saber por el entorpecimiento del aparato, cuando el taladro perfora por entre la mica. Al barrenar, sólo ha de usarse una porción reducida de dinamita cuando se circunda a un depósito de mica; para estos casos, es de preferirse la pólvora negra, si la ocasión es propicia.

La mica, tal como se le obtiene de la mina, consiste en cristales y bloques toscos, que varían desde tamaños pequeños hasta los que miden varios pies de grueso.

Los cristales de mica en bruto son partidos y limpiados de cuarzo pegado, feldespato, o tierra, golpeándolos con un martillo. Luego de esto, se rajan con cuchillos o cuñas, para hacer placas de un diez y seis avo de grueso. Los bordes toscos de las planchas se arreglan por medio de cuchillas que se

sostienen a un ángulo con la hendidura de cristal, y la mica es clasificada entonces de acuerdo con el tamaño y calidad. La mica así clasificada, queda lista para rajarse y recortarse de nuevo, ajustándose a ciertos patrones que se solicitan en el comercio. Las hojas chicas pueden dejarse sin pulir los bordes, y se emplean generalmente para hacer discos y empaquetado, y otras formas de mica. De las piezas chicas de mica se fabrican las hojuelas finas. Para hacer éstas, se recurre a placas de la misma mica, a las que se adereza el borde a formar chaflán, y estos filos se oprimen contra la superficie plana de los cristales, para abrirlos por el hilo. La mica se raja entonces en hojas finas de un quinientosavo de pulgada de grueso, para lo cual se usan cuchillos de hoja muy delgada. Este quehacer se encomienda generalmente a las mujeres, pagándoles la obra por pieza acabada. Las hojuelas finas se utilizan para hacer "tabla" de mica y hojas flexibles de mica. Las tablas o planchas de mica se fabrican con o sin papel de seda, componiéndose de varias hojuelas delgadas, chapeadas con goma laca; las planchas se hacen en tamaños grandes, de 2 por 3 pies, y son puestas bajo fuertes presiones, empleándose en esto las prensas hidráulicas. Mientras son prensadas las hojas, se calientan también, cociéndose, por decirlo así, con lo que se logra que la goma laca se seque. El grueso que se requiere se da a las planchas después de haberlas cocido. Las planchas de mica pueden cortarse o pueden horadarse, igual como se hace con las hojas de mica.

La mica tosca y en pedazos pequeños, así como las sobras de los recortes, se muelen. Son dos los procedimientos para moler o triturar; el seco y el mojado, y se emplea uno o el otro, conforme para lo que se aplicará la mica.

La mica menudamente molida se apli-

Hay varios métodos para practicar los anteriores procedimientos; pero los mas de ellos se guardan en secreto. En el procedimiento de moler por mojado, el siguiente método es el empleado por algunos de los molinos: Dentro de un tonel que contiene mica desmenuzada, se hacen girar mazos de madera provistos de púas; en el tonel se pone agua también. Las púas golpean y desgarran la mica, hasta hacer láminas pequeñas, formándose con esto una masa en el tonel. Después de haber molido lo necesario, se extiende el amasijo sobre mesas de secar, cubiertas con tela y arregladas con tubería de vapor por la parte de abajo. Ya seca la mica, se desbaratan los pilones o marquetas formados, en aparatos adecuados para el objeto, y finalmente, es pasada por cedazos, para clasificarla en cuanto al tamaño.

En la trituración en seco, el pulverizador Raymond u otro tipo de pulverizador, es lo usado en muchos lugares; la mica se rompe por medio de batidores que giran a gran velocidad dentro de una cámara. El producto molido se lleva por conductos por los que se ejerce succión, a los cedazos. Un pulverizador No. 0 Raymond, dará abasto a dos máquinas de cedazo de Barnard & Leas.

Usos de la Mica

Las propiedades físicas enumeradas arriba, hacen a la mica particularmente útil para muchos usos en el mundo industrial, tanto preparada en hoja, como molida. La mica en hojas se usa con más extensión, en la fabricación de aparatos eléctricos y maquinaria; pero en parte se usa también para la cubierta de las estufas, para [illegible] lámparas de petróleo, para pantallas, etc. Solamente la mica clara de buena clase y con perfecto hilo, es la que se emplea en el comercio del barniz.

Para aprovecharla en la maquinaria y aparatos eléctricos, se usa la mica en hojas de varios tamaños y formas, y se usan también los discos de aislamiento no inflamables. Así, pues, hojas propiamente recortadas, son usadas entre los segmentos del conmutador de un motor y dinamo de corriente contínua; se usan para los tubos, hojas y otras formas en los transformadores, y para empaquetado y anillos alrededor de muchos pernos y tornillos que requieren aislamiento. En las lámparas de arco se usan discos y empaquetados grandes, y los de tamaño chico, en las boquillas de las lámparas incandescentes. El lienzo y cinta revestido de mica, flexible, tiene muchos usos en la construcción de algunas de las piezas de los aparatos eléctricos.

La mica molida alcanza hoy gran demanda para la decoración de papeles de colgadura, para la elaboración de lubricantes, pinturas para decorado, efectos de caucho, mica moldeada, papel impermeable para techos, y para cubrir la tubería de vapor.

La mica finamente molida se aplica al papel tapiz, con objeto de darle lustre y brillantez. En este particular empleo, la mica molida y mojada es la que corresponde mejor, pues aseguran que las pequeñas láminas son más limpias y planas que en el producto que se molió en seco. La mica pulverizada, mezclada con aceite, forma un lubricante para ejes y otros soportes, y no poca cantidad se pone a utilidad con este fin. Para la fabricación de pinturas finas, pinturas para objetos decorativos, la mica molida se mezcla con varios colores, y esto sirve bien como pintura metálica. Muchos efectos de caucho contienen mica desmenuzada muy fina, que usan como adulterante, a la vez que para dar al caucho ciertas cualidades deseadas. Si se mezcla con goma laca o yeso, tenemos la forma de la "mica moldeada," que sirve para aislamiento de los cables de fuerza en los tranvías eléctricos, así como otros soportes de esta naturaleza. Papel alquitranado y de otras clases para techos, son cubiertos de lajitas gruesas, o "salvado" de mica, para impedir que el papel se pegue cuando se enrolla al empacarlo. Mica "salvado" y mica de cuerpo aún más tosco, constituye un revestimiento magnífico para las tuberías y calderas de vapor, pues que proteje contra incendio y retiene a éstas su calor.

Por ciertos procedimientos de calcinación, se ha obtenido de cierta biotita o mica de magnesia, que se encuentra cerca de Hecla, condado de Chaffee, Colorado, una mica de color broncíneo. El mineral consiste en una biotita hidratada, que se parece a una clorita. Es de un color verde-negro con lustre apagado. Al calentarse, se extiende o se separa en láminas, y toma un color de oro bronce con lustre metálico, según el tratamiento a que se sujete.

Un nuevo producto que llaman "micarta," se anuncia que ha sido elaborado por la Westinghouse Electric Manufacturing Co. Se intenta este artículo para que reemplace a la fibra endurecida, vidrio, porcelana, caucho duro, planchas de mica, cuero crudo, y compuestos de molde, para usos en conmutadores, manguitos, porta-escobillas, aislamiento, tubos aisladores cerrados, cuerpos de carrete de inducción Ruhmkorff, arrollamiento del imán, separadores de carrete sin alambre y discos para contadores de agua. La "micarta" es dura y de un color rojo claro; es un material homogéneo, que se adapta para hacérsele costuras, para desmenuzarse, tornearse y hacerle rosca. Las hojas delgadas pueden horadarse y se asegura que no se tuercen ni se expanden ni encogen, más allá de limitadas proporciones.

Se hacen dos clases de "micarta;" una se conoce por el nombre de "micarta bakelite," que es infundible, resiste el calor hasta el punto en que comienza la carbonización de algunos de sus ingredientes. Esta variedad es insoluble y no la afectan los solventes, como el alcohol, bencina, trementina y soluciones de base ácida o álcali.

Producción de la Mica

El valor total de la mica producida en los Estados Unidos durante el año de 1913, fué de $136,960.

Precios

El precio medio de la mica en hojas, en los Estados Unidos, durante el año de 1913, según se ha calculado, considerando el total de la producción, fué de 20.8 centavos la libra, valor que en 1912, fué de 33.4 centavos, y en 1911, 16.4 centavos. El precio medio de la mica en recortes durante el año de 1913, según cálculo tomando en consideración la producción total, fué de $15.51 por tonelada de 2,000 libras, lo que en 1911 fué de $15.21. En Carolina del Norte, el precio fué de $13.64; en Nueva Hampshire, $20.09; en Nuevo México, $15.26, y en Dakota del Sur, $17.60.

Apuntes Prácticos para el Uso de los Mineros. (*)

I

Regla de Metales

Esta parte de la aritmética enseña a calcular todas las cuestiones referentes a los minerales, o sea determinar el contenido fino que hay en ellos, determinar leyes medias, hacer mezclas y determinar los valores de las partidas, conocidos sus pesos, leyes y condiciones de compra o venta.

Mineral es todo cuerpo inorgánico explotable, que contiene una parte útil, que es el metal, y la otra inútil, que es lo que se llama criadero.

Ley es la relación que existe entre el metal puro contenido en una cantidad determinada del mineral y el criadero.

Para expresar la ley de los minerales de cobre, manganeso, cobalto, níquel, estaño, fierro, magnesio, mercurio, plomo, zinc y otros más, se usa el **tanto por ciento.**

Un mineral de 30 por ciento de cobre, por ejemplo, significa que en cien partes de mineral hay 30 de cobre puro, y las 70 restantes es criadero u otras substancias.

Plata

Diversas maneras hay para expresar la ley de los minerales de plata:

1o. **En marcos por cajón.**—El cajón de minerales es el peso de 64 qq. españoles, ó 6,400 libras.

Minerales de plata de 80 marcos por cajón, significa que en los 64 qq. esp., se encuentran 80 marcos de plata fina, y el resto de criadero.

El marco equivale a media libra justa.

1 marco igual a media libra, igual a 8 onzas, igual a 23 decágramos, igual a 230 gramos.

Luego, el cajón de 64 qq. esp. es igual a 6,400 libras, ó 12,800 marcos.

2o. **En diez milésimos,** que se escribe D. M.

Decir que un mineral de plata tiene 300 D. M., significa que en diez mil partes hay 300 de plata pura, y 9,700 partes de criadero u otras substancias. La ley en piñas o plata en barra, se expresa en milésimos, que se escribe M.

Decir que una barra tiene 970 M., significa que en mil partes hay 970 partes de plata pura, y lo demás corresponde a otras substancias.

Muy a menudo se necesita transformar leyes expresadas en marcos a leyes expresadas en D. M., o viceversa. Entonces tendremos que saber la equivalencia que hay entre un marco y un D. M.

Para esto, sabemos que un cajón contiene 12,800 marcos, y que para las leyes expresadas en D. M. la unidad se dividió en diez mil partes; luego, si 10,000 partes de fino equivalen a 12,800 marcos, un diez milésimo ¿a cuántos marcos equivaldrá?

$$10000 : 12800 :: 1 : x$$

$$x = \frac{12800 \times 1}{10000} = 1{,}28$$

Entonces, 1 D. M. es igual a 1,28 marcos.

Se pueden deducir entonces, de esto, las siguientes

Reglas.—Para reducir una ley expresada en marcos a D. M., bastará dividir el número dados por 1,28.

Ejemplo: Una ley de 68 marcos por cajón, ¿cuántos D. M. significan?

$$6800 : 1{,}28 = 53{,}125 \text{ D. M.}$$

Regla.—Una ley expresada en D. M., queremos expresarla en marcos por cajón, se multiplica el número de D. M. por 1,28.

Ejemplo: ¿A cuántos marcos por cajón equivale una ley de 53,125 D. M.? $1{,}28 \times 53{,}125 = 68$ marcos por cajón.

Pueden también determinarse estas equivalencias haciendo una proporción. Para esto, reduciremos los qq. esp. a gramos, lo mismo los marcos que se nos dan.

Los 64 qq. esp. equivalen a 2944000 gramos.

Los 68 marcos equivalen a 15640 gramos.

Con estos datos, para saber la equivalencia de los 68 marcos en D. M., formaremos la siguiente proporción:

Si en 2944000 hay 15640 grs., en 10000 ¿cuántos habrá?

$$2944000 : 15640 :: 10000 : X$$

$$x = \frac{15640 \times 10000}{2944000} = 53{,}125 \text{ D. M.}$$

Regla.—Se multiplica el número de marcos, reducido a gramos, por 10000, y el producto se divide por el número de qq. esp. que tiene el cajón, reducido a gramos; el resultado nos dará el equivalente, de una ley expresada en marcos, en D. M.

Para reducir una ley expresada en D. M. a ley expresada en marcos por cajón, se usará la siguiente:

Regla.—Se multiplica el número de qq. esp. que tiene el cajón, reducido a gramos, por el número de diez milésimos dados. Este producto se divide por 10000, y éste, a su vez, se divide por 230. El resultado dará marcos por cajón.

3o. **En Onzas troy.**—En el mercado inglés, la ley de plata se expresa en onzas troy. La onza troy se refiere a la tonelada inglesa de 2240 libras ó 1015.0 kilos.

Un mineral de plata de 500 onzas troy, significa que en la tonelada inglesa tenemos el peso de 500 onzas troy de plata fina, y el resto de otras substancias.

Tomemos siempre el ejemplo anterior de 68 marcos por cajón, y veamos su equivalente en ley expresada en onzas troy, o, en otros términos, expresar los marcos en onzas troy.

Averiguaremos cuántos gramos hay en 68 marcos, multiplicando a 68 por 230, igual a 15640 grs.

Después, los 64 qq. esp. son 2944000 grs.

Hecho esto, formaremos la proporción siguiente:

En 2944000 hay 15640; en el número de grs. que tiene la tonelada inglesa, ¿cuántos habrá?

La onza igual a 31,103 grs.

La tonelada inglesa igual a 1015900 grs.

$$2944000 : 15640 :: 1015900 : x$$

$$x = \frac{1015900 \times 15640}{2944000} = 5396{,}9008 \text{ grs.}$$

Como la onza troy tiene 31,103 grs., dividiremos a 53969008 por 31,103, y el cuociente nos dará la ley expresada en onzas troy.

$5396{,}9008 : 31{,}103 = 173{,}517$ onzas troy.

Regla.—Para reducir una ley expresada en marcos a ley expresada en onzas troy, se multiplica el número de gramos que tiene la tonelada inglesa (1015900 por los marcos dados, reducidos a gramos; esto se divide por 64 qq. esp., reducidos a gramos (2944000), y el cuociente se divide, a su vez, por 31,103.

Para hacer la operación contraria, es decir, reducir una ley expresada en onzas troy a marcos, se puede usar la siguiente

Regla.— Se multiplican los gramos que tiene el cajón por el número de onzas, reducidas a gramos; esto se parte por el número de gramos que tiene la tonelada inglesa, y esto, a su vez, se divide por 230.

Con estas reglas, y las dadas anteriormente, podemos fácilmente reducir las leyes expresadas en D. M. a marcos y a onzas troy.

Dato.—A veces se da el precio de compra a tanto el marco, y nosotros tenemos el fino en kilo; tendremos que reducir los kilos a marcos, y usamos esta

Regla.—Para reducir kilos a marcos, se multiplica el número de kilos por 4,347, y para reducir marcos a kilos se divide el número de marcos por 4,347.

4o. **En gramos por tonelada.**— Decir que un mineral tiene 40 gramos por tonelada, significa que en una tonelada, o sea un millón de grs., hay 40 grs. de plata pura, y lo demás criadero.

Cuando se nos da la ley en esta forma y queremos expresarla en D. M., bastará dividir el número de gramos por 100.

Ejemplo.— ¿Cuántos D. M. son 420 gramos por tonelada?

$420 : 100 = 4{,}20$ D. M.

Todo lo contrario, para reducir una ley expresada en D. M. a ley expresada en gramo por tonelada, bastará multiplicar el número de D. M. por 100.

(*) Escrito por el Sr. L. Nicolás Puelma Q. en el Boletín de la Sociedad de Minería.

Ejemplo.—4,20 D. M. ¿cuántos gramos por tonelada son?

4,20 x 100 =420 gramos por tonelada.

Minerales de Oro

Hay varias maneras de expresar la ley del oro.

1o. En cien milésimos.—Es costumbre escribirlo C. M.

Decir que un mineral tiene 8 C. M., significa que en cien mil partes hay 8 de oro puro, y lo demás de otras substancias.

El oro en barras se expresa en milésimas, que se escribe M. El oro químicamente puro tendrá entonces mil milésimas.

2o. En onzas por cajón.—Siete onzas por cajón significa que en 64 quintales españoles hay 7 onzas de oro puro, y lo demás de otras substancias.

1 onza =28.756 gramos.

Muchas veces se necesita saber el equivalente de C. M. en onzas.

Para esto, sabemos que una ley expresada en 100,000 partes, equivale al cajón expresado en onzas, o sean 102,400 onzas.

Luego 100,000 : 102,400 :: 1 : x

$$x = \frac{102{,}400 \times 1}{100{,}000} = 1{,}024$$

1 C. M. =1,024 onzas.

Regla.—Para reducir onzas a C. M., se divide el número de onzas por 1,024; el cuociente es el número de C. M.

Ejemplo.—20 onzas ¿cuántos C. M. son?

2,000 : 1,024 =19,531 C. M.

Lo contrario. Ahora, para reducir C. M. a onzas, se usará la siguiente

Regla.—Se multiplican las C. M. por 1,024, y el producto da la ley en onzas.

Ejemplo.—19,531 C. M. ¿cuántas onzas son?

19,531 x 1,024 = 20 onzas.

También puede emplearse el método de proporciones para hacer las reduciones de onzas a C. M., o de C. M. a onzas, y de ellas se deducen las siguientes reglas:

Regla 1a.—Para reducir onzas a C. M. se multiplica el número de onzas por 28,756; este producto se multiplica por 100,000, y esto se parte por 2,944,000. El cuociente da el número de C. M.

Regla 2a.—Para reducir C. M. a onzas, se multiplica 2,944,000 por el número de C. M.; el producto se divide por 10,000, y éste, a su vez, se divide por 28,756.

3o. En gramos por toneladas.—Decir que una ley es de 90 gramos por tonelada (métrica), quiere decir que en mil kilos, o sea un millón de gramos, hay 90 gramos de oro fino, y lo demás otras substancias.

Como será fácil comprender, una ley expresada de esta manera, se puede también reducir a C. M. u onzas.

Se tiene, por ejemplo, un mineral de 90 gramos por tonelada, y queremos expresarla en C. M.

Haremos la siguiente proporción: si en 1.000,000 de gramos hay 90 gramos, en 100,000 ¿cuántos habrá?

1.000.000 : 90 :: 100,000 : x

$$x = \frac{90 \times 100{,}000}{1.000{,}000} = 9 \text{ C. M.}$$

De esta proporción simplificada deducimos la siguiente

Regla.—Para reducir una ley expresada en gramos por toneladas a C. M., bastará dividir el número de gramos dados por 10.

Regla.—Para reducir, ahora, una ley expresada en C. M. a ley en gramos por tonelada, bastará multiplicar el número de C. M. por 10.

Ejemplo.—Una ley de 9 C. M. ¿a cuántos gramos por tonelada equivalen?

9 x 10 =90 gramos por tonelada.

4o. En quilates.—Este modo se aplica sólo para las aleaciones, y se supone la unidad dividida en 24 partes iguales, que se llaman **quilates**. Los quilates, a su vez, se dividen en 24 partes iguales, que se llaman **granos**.

A veces se presentan casos de reducir ley expresada en milésimas a quilates. Para esto, haremos la siguiente proporción:

1,000 es a la ley en quilates como 24 es a x.

Ejemplo.—Una ley de 800 milésimas expresarla en quilates:

1,000 : 800 :: 24 : x

$$x = \frac{24 \times 800}{1000} = 19{,}20 \text{ quilates.}$$

Regla.—Para reducir una ley expresada en milésimos a ley expresada en quilates, se multiplica a 24 por el número de milésimos dados, y esto se divide por 1,000.

Si deseamos reducir una ley de quilates a milésimos, se usará la siguiente

Regla.—Se multiplica a 1,000 por el número de quilates, y el producto se divide por 24.

Ejemplo.— ¿Cuántos milésimos son 19,20 quilates?

1) 1,000 x 19,20 =19,200.

2) 19,200 : 24 =800 M.

Reducir quilates a tanto por ciento.

Regla.— Se multiplica el número de quilates por 100, y esto se divide por 24.

Ejemplo.—14 quilates ¿a cuánto por ciento equivalen?

1) 4 x 100 =3,400.

2) 1,400 : 24 =58,33 por ciento.

II PARTE

Contenido fino.—Contenido fino es el metal puro que contiene un mineral.

Voy a tratar la manera cómo determinarlo.

Hay dos métodos:

1o. Se multiplica el peso por las leyes, y este producto se divide por 100, si está expresado en tanto por ciento; por 1,000 si está expresado en milésimas; por 10,000 si está expresado en D. M., y por 100,000 si está expresado en C. M. (1).

Primer ejemplo.—¿Qué contenido fino de cobre tenemos en una partida de minerales de diez quintales métricos de 8 por ciento de ley?

10 x 8 =80.

80 : 100 =8,80 quintales métricos, o sean 80 kilos de fino.

Segundo ejemplo.—¿Qué fino hay en una partida de 20 quintales métricos de minerales de plata de ley de 8 D. M?

20 x 8 =160.

160 : 10,000 =0,016 quintales métricos, o sean 1,600 gramos.

Tercer ejemplo.—¿Cuánto de fino tiene una partida de minerales de oro de 40 quintales métricos de ley de 8 C. M?

40 x 8 =320.

320 : 100,000 =0,00320 quintales métricos, o sean 320 gramos.

2o. Podemos hacerlo por medio de proporciones. Para esto, tomaré los mismos ejemplos anteriores.

El primer ejemplo.—Diremos: Si en 100 gramos hay 8 gramos de fino, en 1.000,000 de gramos (que es el peso del mineral, 10 quintales métricos reducidos a gramos) ¿cuánto habrá?

100 : 8 :: 1.000,000 : x.

$$x = \frac{8 \times 1.000{,}000}{100} = 0{,}80$$

quintales métricos, o sean 80 kilos.

Leyes medias

Ley media es encontrar entre varias partidas de minerales de diferentes leyes, la ley que darían mezclados todos juntos.

Regla.—Para hallar la ley media de varias partidas de minerales, se multiplica el peso de cada especie por su ley respectiva. Se suman después los productos, y la suma se divide por la suma de los pesos de todas las especies.

Ejemplo.—Tenemos las siguientes partidas de minerales; se nos pide determinar la ley media:

80... mt. de ley 15%	80..15	=1200
50 ,, ,, ,, ,, 18 ,,	50..18	= 900
270 ,, ,, ,, ,, 12 ,,	270..12	=3240
400		5340

5340 : 400=13,3%.

La ley media será entonces de 13,3 por ciento.

Otro ejemplo.—Tenemos:

20 qq. mt. de minerales de oro de ley 5 C. M. . . .	5x20=100
12 qq. mt. de minerales de oro de ley 10 C. M. . . .	12x10=120
15 qq. mt. de minerales de oro de ley 8 C. M. . . .	15x 8= 120
47	340

340 : 47 =7,2 ley media.

Mezclas

A veces se desea mezclar varias partidas de minerales de diferentes leyes, para obtener una ley dada, y, por supuesto, se necesita determinar la cantidad de mineral de cada pila que hay que

(1) También se puede hacer multiplicando el peso por la ley escrita en números decimales.

mezclar. Con un ejemplo podemos entender mejor la operación que hay que hacer.

En una mina se tienen minerales de 12, 17, 8 y 16 por ciento; se desea mezclarlos y obtener una ley media de 15 por ciento. Averiguar la proporción en que deben mezclarse.

Nos servimos para esto de la siguiente

Regla.—Se restan sucesivamente las leyes inferiores de la ley media dada, y la suma de estas diferencias da las unidades de las leyes superiores que debe entrar en la mezcla. En seguida se restan sucesivamente la ley media de todas las leyes superiores, y la suma de estas diferencias da las unidades de las leyes inferiores que deben entrar en la mezcla.

15%	12%	15−12= 3	17−15=2
	17 ,.	15− 8= 7	16−15=1
		—	—
	8%	10	3
	16 .,		

Restando las leyes inferiores de la ley media 15, nos da 95—12—3 y 15—8=7; sumamos entonces estos resultados: 3 + 7 = 10. En seguida restamos 17—15 = 2, y 16 — 15 = 1. Estos resultados también los sumamos. Tenemos entonces, siguiendo la regla, que debemos mezclar, en la proporción de 10 a 3. Así:

10 qq. o grs. o kilos de 17%
10 ,, ,, ,, ,, 16
3 ,, ,, ,, ,, 12
3 ,, ,, ,, ,, 8

Si queremos comprobar si la operación está bien hecha, no tendremos más que determinar con estos datos la ley media que tendrá que darnos 15 por ciento.

Determinar la ley media.

10	17%	10 17=170
10	16 ,.	10 16=160
3	12 ..	3 12— 36
3	8 ,	3 8= 24
—		——
26		390

390 : 26=15%

Otro método.—Tomaremos el mismo ejemplo anterior.

15% (17% / 16 ,, / 12 , / 8 ,,

Si tomamos del mineral de 17 por ciento, el aumento de la ley será de 2 por ciento para la unidad de peso; para que sea 1 por ciento el aumento, necesitará un medio de la unidad de peso.

De la ley de 16 por ciento el aumento será 1 por ciento para la unidad de peso.

Del mineral de 12 por ciento, la disminución de la ley media será de 3 por ciento; para que sea de 1 por ciento la disminución, necesitará un tercio de la unidad de peso.

Del mineral de 8 por ciento la disminución de la ley será 7; para que sea de 1 por ciento necesitará un séptimo de la unidad de peso.

15% (17% el aumento es de 2% para que sea 1% ....½ / 16% el aumento es de 1% para que sea .....1 / 12% la disminución es 3%, para que sea 1% .....⅓ / 8% la disminución es 7%, para que sea 1% .....⅐

Si queremos tener el resultado en números enteros, bastará multiplicar los resultados obtenidos por el producto de todos los denominadores. En este caso será 2 x 3 x 7 =42.

½ de 42 = 21 kgs. o qq o grs.
1 de 42 = 42 ,, ,, ,,
⅓ de 42 = 14 ,, ,, ,,
⅐ de 42 = 6 ,, ,, ,,

Resultado entonces que, mezclando 21 partes de 17 por ciento con 42 de 16 por ciento, con 14 de 12 por ciento y con 6 de 8 por ciento, tendremos una mezcla cuya ley será de 15 por ciento.

Nota.—En caso de que las leyes inferiores sean más que las superiores, o viceversa, es necesario establecer exacta compensación entre la pérdida y la ganancia.

Así, por ejemplo, tenemos minerales de 16, 18, 20, 8 y 6 por ciento, y queremos mezclarlos para obtener una ley media de 14 por ciento. ¿En qué proporción debemos mezclarla?

En este caso tenemos tres leyes mayores de 14 por ciento y dos menores. Para hacer la compensación, tomaremos dos veces una de las leyes menores, por ejemplo, la de 6 por ciento, y así tendremos tres mayores y tres menores.

14%	16%	2%	1% ½
	18 ,,	4 .,	1 ,. ¼
	20 ,.	6 ,,	1 ,, ⅙
	8 .,	6 ,.	1 ,, ⅛
	6 ,,	8 ,,	1 ,, ⅛
	6 ,,	8 ..	1 ,, ⅛

Multipliquemos ahora por el producto de todos los denominadores 2 x 4 x 6 x 6 x 8 x 8 = 18432, y ejecutemos la operación.

Nos queda:

½ x 18432=9216
¼ x 18432=4808
⅙ x 18432=3072
⅙ x 18432=3072
⅛ x 18432=2304
⅛ x 18432=2304

Resultado entonces que mezclaremos:

9216 qq. o grs. o kilos de 16%
4608 ,, ,, ,, ,, 18,,
3072 ,, ,, ,, ,, 20,,
3072 ,, ,, ,, ,, 8,,
2304 ,, ,, ,, ,, 6,,
2304 ,, ,, ,, ,, 6,,

Las personas que saben operar con quebrados, pueden hacer las operaciones simplificándolas. (1).

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(1). Para simplificar se suprimen los denominadores que estén contenidos en otro de ellos.

Si queremos comprobar si el problema está bien resuelto, haremos lo mismo que en el método anterior.

III PARTE

Venta de minerales

Cobre.—Las casas compradoras de estos minerales fijan siempre para los vendedores el precio a que pagan un qq. métrico de mineral de 10 por ciento.

Cuando el mineral pasa de esta ley, por cada unidad más pagan un cierto número de centavos, y a esto llaman **escala de subida.**

Cuando la ley es menor de 10 por ciento, pagan un cierto número de centavos menos por cada unidad que baja de diez por ciento. Esto se llama **escala de bajada.**

Por ejemplo: ¿Cuánto vale el qq. mt. de minerales de cobre de 12 por ciento de ley, pagando la casa compradora al siguiente precio, que lo fija escrito en una pizarra?

El 10 por ciento a $8.00.
Escala de subida $0.70.
Escala de bajada $0.80.

Averiguamos primero la diferencia que hay entre la ley del mineral y el 10 por ciento. En este caso es 2 por ciento. Como por cada unidad de ley que pase de 10 por ciento pagan $0.70, tendremos que para 2 por ciento será 2 x 0.70 =$1.40.

El qq. de 10 por ciento cuesta $8.00, el de 12 por ciento costará 8.00 + 1.40 =$9.40.

Otro ejemplo.—¿Cuánto vale el qq. métrico de minerales de cobre de 6 por ciento, tomando los mismos precios fijados anteriormente?

Vemos la diferencia que hay entre 10 por ciento y 6 por ciento, que es 4 por ciento. Como por cada unidad menor de 10 por ciento descuentan $0.80, tendremos que para los 4 por ciento será de 4 x 0.80 =3.20.

El qq. mt. de 6 por ciento costará 8.00 — 3.20 =$4.80.

Problemas sobre ventas de grandes partidas de cobre

Un minero ha extraído de su mina 82 qq. mt. de minerales de cobre de ley de 14 por ciento, y los va a vender a una casa compradora que tiene fijados los precios siguientes:

El 10 por ciento a $8.50.
Escala de subida $0.75.
Escala de bajada $0.80.
Se pregunta el valor de la partida.

Solución.— Diferencia entre 10 por ciento y 14 por ciento, 4 por ciento; a $0.75 cada unidad que pase de 10 por ciento, será 0.75 x 4 =$3.00.

Como el 10 por ciento lo pagan a $8.50, el qq. de 14 por ciento valdrá 8.50 + 3.00 = $11.50. Entonces el qq. de 14 por ciento vale $11.50, los 82 qq. valdrán 82 x 11.50 =$943.00.

Otro ejemplo.—Se han extraído de la mina Centenario la cantidad de 120.50 qq. mt. de minerales de cobre, de ley de 7 por ciento. Se desea saber el valor de la partida.

El precio que fija la casa compradora es el mismo anterior.

Lo primero será averiguar la diferencia entre 10 y 7 por ciento, que es igual a 3 por ciento. Por cada unidad que baja de 10 por ciento, le descuentan $0.80; luego en las tres unidades le descuentan que si un qq. de 7 por ciento lo pagan a $8.50, el 7 por ciento lo pagarán a 8.50 — 2.40 =$6.10. Tenemos entonques que si un qq. de 7 por ciento vale $6.10, los 120.50 valdrán 120.50 x 6.10 =$735.05.

Otra forma de venta.—A veces se hacen contratos con las casas compradoras, poniendo en ellos cláusulas que son aceptadas por ambas partes.

Por ejemplo: la Casa Ore Trading y Compañía hace un contrato en esta forma:

1.—Los minerales deberán tener una ley común de 5 por ciento de cobre como mínimum;

2.—Se pagarán al término medio de las cotizaciones Jackson del mes respectivo, formándose la escala con el término medio del precio de la barra en el mismo mes, menos $2.00 por unidad y tonelada.

Como se comprende, nosotros debemos saber cuánto es el valor del quintal métrico, y esto es lo que voy a determinar.

Ejemplo.—Supongamos que el mineral tenga 6 por ciento de ley.

El término medio de la cotización Jackson, puesto a bordo, por quintal métrico, supongamos sean $7.80.

Precio de la barra de 100 kg. es $147.00.

Solución.—Como los 100 kg. valen $147.00, un kg. valdrá la centésima parte, es decir, 147 : 100 =$1.47.

De esto tendremos que rebajar $0.20, que es lo que nos descuentan por unidad y quintal métrico.

1.47—0.20=1,27.

Este resultado es lo que nos descontarán por cada unidad que baja del 10 por ciento.

Nos queda ahora nada más que determinar cuánto nos costará el quintal de 6 por ciento.

Vemos la diferencia que hay entre esta ley y el 10 por ciento; es 4 por ciento, a $1.27 cada unidad, será igual a 1.27 x 4 =$5.08.

El quintal métrico de 10 por ciento vale $7.80.

El quintal de 6 por ciento valdrá 7.80—5.08=$2.72.

Venta de minerales de plata

1) En la mina Elisa se tienen en cancha 422 qq. mt. de minerales de plata, de ley de 14 D. M. Se desea hacer la venta, sabiendo que la casa compradora tiene fijado en $100 el kilo fino.

¿Cuánto será el precio de la venta?

Solución.— 1er. método: 422 x 14=5908.

5908 : 10000 =0,5908 qq. mt., o sean 59,08 kilos a $100, valdrán 59,08 x 100 =$5908,00.

2o. método.—Averiguaremos el contenido fino.

Si en 10,000 grs. hay 14 de fino, en 42,200,000 ¿cuánto habrá?

10,000 : 14 :: 42.200,000 : x.

$$x = \frac{14 \times 42.200,000}{10,000} = 59.080.00 \text{ grs., o sean } 59,08 \text{ kl.}$$

a $100, valdrá 59.09 x 100 =$5,908.

Nota.—Aquí se pueden ejercitar en ejemplos, cuyas leyes estén expresadas en onzas troy y marcos, y los precios fijados a tanto el kilo fino o a tanto el marco.

Venta de minerales de oro

1) La casa de Lota compró 150,80 qq. mt. de minerales de oro de ley de 8 C. M., pagando el kilo fino a $3,500.00. ¿Cuánto costó la partida?

Solución.— Averigüemos primero el contenido fino.

150.80 x 8 =1,206.40.

1,206.40 : 100,000 =0.0120640 qq. mt., o sean 1.2064 kilo fino, a $3,500 kilo, tendremos que el valor de la partida costará 1,2064 x 3,500 =$4222.40.

2o. método: 100,000 : 8 :: 15.080,000 : x

$$x = \frac{15.080,000 \times 8}{100,000} = 1206,4 \text{ grs., o sean } 1,2064 \text{ kl.}$$

a $3,500 kl., costará la partida

1,2064 x 3,500 =$4,222,40

Nota.—También se cotiza el oro a tanto la onza, mientras más ley tienen los minerales, mejor precio se paga.

A veces se presentan las ventas de minerales, combinado con cobre, oro y plata. Para resolver estos problemas se siguen los mismos métodos anteriores.

Ejemplo.—Se han extraído de una mina una partida de minerales de 345.60 qq. mt. Estos minerales ensayados han dado 8 por ciento de cobre, 7 D. M. por plata y 5 C. M. por oro. Se desea saber su valor, conociendo los precios fijados por la casa compradora, y que son los siguientes:

Cobre.—El 10 por ciento, a $9.00.
Escala de subida, a $0.80.
Escala de bajada, a $0.90.
Plata.—El kilo fino, a $90.00.
Oro.—El kilo de fino, a $3,400.

Operación.—Encontraremos primero el valor por cobre 345.60 qq. mt., 8 por ciento.

1) 0.90 x 2 =$1.80.
2) 9.00
1.80

7.20 vale el qq. de 8 por ciento.

3) 345.60 x 7.20 =2,488.32, precio por cobre.

Ahora determinaremos el precio por plata.

345.60 qq. mt., 7 D. M.

345.60 x 7 =2,419.20.

2,419.20 : 10,000 =0,241920 qq. mt., o sean 24,192 kilos de fino, a $90 kilo, costará 24.1920 x 90 =$2,177.28.

Por último, determinaremos el precio del oro, averiguando primero el fino que contiene la partida.

345.60 qq. mt., 5 C. M.

345.60 x 5 =1728.00,

1,728 : 100,000 = 0.01728 qq. mt., o sean 1,728 kilos de oro fino, a $3,400 kl., valdrán 1,728 x 3,400 =$5875.00, precio del oro fino contenido en la partida.

Luego el total de la venta será la suma de los tres valores determinados.

Cobre.	$ 2,488.32
Plata	2,177.28
Oro.	5,875.20
Total.	$10,540.80

Ligas

Se llaman ligas a los cuerpos que se obtienen fundiendo dos o varios metales juntos.

Lingote.—Es una liga o una masa de oro o de plata o de cobre puro, que conserva aún la forma del molde en que se ha fundido.

La ley de un lingote se expresa en milésimos.

Los problemas que se presentan son más o menos los mismos que ya hemos estudiado anteriormente, con los minerales. Así por ejemplo:

1) Se ha hecho una liga de tres lingotes de oro, que pesan, respectivamente, 180 grs., 45 grs. y 140 grs., y cuyas leyes son 720 M., 512 M. y 815 M.

Se desea saber la ley de la liga.

Este problema, como se ve, no es más que determinar la ley media.

180 grs..	720 M..	180 x 720=	129,600
45 ,, ..	512 ,,..	45 x 512=	23,040
140 ,, ..	815 ,,..	140 x 815=	114,100
365		peso total	266,740

266,740 : 365=730,7 M. ley de la liga.

2) ¿En qué proporción se deben ligar dos metales de leyes diferentes para obtener un lingote de una ley dada?

Ejemplo.—Se tienen dos lingotes de oro, el primero tiene una ley de 958 M. y el segundo una ley de 870 M. ¿En qué proporción deben ligarse para obtener una liga de 910 M?

Usaremos las mismas reglas que para los minerales.

910..... { 958 M..... 40
870 ,, ...48

Debemos mezclar en relación de 40 partes del primero por 48 del segundo.

Problemas

1.—Una partida de minerales de plomo, cuyo peso es de 185,25 kilos y la ley de 60 por ciento, ¿cuánto fino contiene? R. 111.15 kls. fino.

2.—¿Qué ley da en D. M. un gramo de

mineral que tiene 5 miligramos de fino? R. 50 D. M.

3.—¿Qué cantidad de marcos de plata hay en 768 qq. esp. de minerales de ley de 45 marcos? R. 540 marcos.

4.—Para un ensayo de plata se han tomado 10 grs. de tierra. El botón que resultó en la copela pesó 5 miligramos. ¿Cuál es la ley del mineral en D. M?

Si en 10 grs. hay 0.005 grs. de fino, en 10,000 grs. ¿cuánto habrá?

$$10 : 0.005 :: 10{,}000 : x$$

$$x = \frac{0.005 \times 10{,}000}{10} = 5 \text{ D. M.}$$

5.—Para un ensayo de oro se tomaron 20 grs. de mineral, y el botón de oro que resultó pesó 10 miligramos. ¿Qué ley da el mineral en C. M?

$$20 : 0.01 :: 100{,}000 : x$$

$$x = \frac{0.010 \times 100{,}000}{20} = 50 \text{ C. M.}$$

6.—Se vende 1.87 kl. de plata, a $8.75 el marco. ¿Cuánto vale? R. $71,137.

7.—Una persona va a comprar una cadena de oro, que pesa 50 grs. y la ley es de 14 kilates. Deseamos saber cuántos gramos de oro fino contiene.

Solución.—24 kilates equivalen a ciento por ciento, 14 kilates ¿a cuánto equivalen?

$$24 : 100 :: 14 : x$$

$$x = \frac{14 \times 100}{24} = 58.33 \text{ por ciento.}$$

Como se ve, con esta proporción determinamos a cuánto por ciento equivalen 14 kilates.

Ahora diremos. si en 100 gramos hay 58,33 de fino, en 50 grs. que pesa la cadena, ¿cuánto fino habrá?

$$100 : 58{,}33 :: 50 : x$$

$$x = \frac{58{,}33 \times 50}{100} = 29.16 \text{ gramos de fino}$$

que hay en la cadena.

De aquí podemos deducir la siguiente

Regla.—Se reduce la ley en kilates a la ley en tanto por ciento, y esto se multiplica por el peso en gramos del objeto dado, y este resultado se divide por 100.

También puede darse una regla más sencilla y fácil para la práctica. Se multiplica la ley en kilates por el peso en gramos, y este resultado se divide por 24.

8.—La exportación anual del salitre es, más o menos, de 60.000,000 de qq. esp., y el fisco cobra por derechos 28 peniques por qq. El costo de la elaboración y explotación es de 17 peniques por qq.; la cotización en Londres es de 8 chelines por qq. Se desea saber: 1o. La entrada anual del fisco. 2o. El valor de la producción. 3o. Costo de la elaboración y explotación, y 4o. Utilidad de los dueños.

Solución.—La entrada anual del Fisco igual a 60.000,000 x 28 =1,680.000,000. El valor total de la producción se determinará averiguando cuántos peniques son 8 chelines, y para esto se multiplicará a 8 por 12 peniques que tiene el chelín, así: 12 x 8 =96 peniques. Entonces, como por cada qq. esp. pagan 96 peniques, los 60.000,000 valdrán..... 60.000,000 x 96 =5,760.000,000 peniques, El costo de la elaboración y explotación será igual a 60.000,000 x 17 = 1,020.000,000 peniques.

La utilidad de los dueños será igual a 60.000,000, menos el total de gastos

5,760.000,000
—2,700.000,000

3,060.000,000 utilidad de los dueños.

Reglas prácticas

1) Tres mineros trabajan una labor a razón de $80.00 el metro, y han recorrido 4.75 metros.

El primero trabajó 11 días; el segundo, 6 días, y el tercero, 17 días. ¿Cuánto ha ganado cada uno?

Solución.—Se averigua primero el valor total de los metros, que en este caso es 80 x 4.75 =$380.00. y en seguida se aplica la siguiente

Regla.—Se multiplica el número propuesto por el número proporcional correspondiente a cada parte, y el producto se divide por la suma de los números proporcionales.

En el problema el número propuesto es el valor de los metros, $380,00. Los números proporcionales son 11, 6 y 17.

$$\text{El 1er. hombre} = \frac{380 \times 11}{34} = \$122.94.$$

$$\text{El 2o. hombre} = \frac{380 \times 6}{34} = \$\ 67.06.$$

$$\text{El 3er. hombre} = \frac{380 \times 17}{34} = \$190.00.$$

Para comprobar este problema, bastará sumar los 122.94 + 67.06 + 190.00, y esto debe dar el número propuesto, 380.

2) Un pirquinero ha sacado minerales por valor de $988.60, y debe darle al dueño de la mina el 15 por ciento. ¿Cuánto deberá entregar?

Regla.—Se multiplica el capital por el tanto por ciento, y este producto se divide por 100.

Solución.—988.60 x 15 =14,829.00.
14,829.00 : 100 =$148.29.

Debe dar entonces al dueño de la mina $148.29.

3) Para colocar una máquina de extracción en una mina hay necesidad de echar abajo una punta de cerro. El largo de ella es de 18,60 mts., el ancho 15,45 mts.; los altos tomados en diferentes partes nos han dado 0,60; 0,75; 0,20; 1,08; 1,01; 0,80; 0,98 y 0,74 mts.

El precio por metro cúbico cuesta $21.00. Se desea saber cuánto valdrá la destrucción de esta punta.

Solución.—Determinaremos los metros cúbicos multiplicando el ancho por el largo y por el alto medio.

Tenemos largo 18,60 mts., ancho 15,45 mts. y alto medio 0,77 mts.

Para determinar el alto medio se suman todas las alturas dadas, y esto se divide por el número de términos.

0,60
0,75
0,20
1,08
1,01
0,80
0,98
0,74
——
6,16 : 8 = 0,7777

Con estos datos ejecutamos las multiplicaciones.

15,45 x 18,6 =287,37

287,37 x 0,77 =221,274 mts. cúbicos, a $21,00 el mt. cc. valdrán 221,274 x 21 =$4,646.77.

4) Se quiere comprar una máquina de extracción para una mina, y se han pedido precios por igual máquina a Hamburgo, a Londres, a Estados Unidos y a Francia.

El precio en Hamburgo es de 15,000 marcos.

El precio en Londres es de 720 libras esterlinas.

El precio en Estados Unidos es de 3,400 dóllars.

El precio en Francia es de 18,000 francos.

El cambio está a 9 siete octavos.

Se desea saber en qué parte es más barata, para efectuar su compra.

Solución.—Lo que hay que hacer en este problema es reducir los marcos, las libras esterlinas, los dóllars y los francos a moneda chilena, y para esto daré las reglas siguientes:

1.—Reduzcamos un marco a moneda chilena, estando el cambio a 9 siete octavos.

Regla.—Para reducir marcos a moneda chilena, basta dividir a 48 por el cambio sobre Londres, y esto se parte por 4, número fijo.

$$(1)\ 48 : 9\tfrac{7}{8} = 48 : \frac{79}{8} = \frac{48 \times 8}{79} = 4{,}86$$

$$4{,}86 : 4 = \$\ 1{,}21$$

El marco vale $1,21, moneda corriente.

2) Reduzcamos la libra esterlina a moneda chilena.

Regla.—Para saber el valor de la libra esterlina en moneda chilena, se divide a 240 por el cambio dado sobre Londres.

Una libra esterlina al cambio de 9 siete octavos ¿cuánto vale?

$$240 : 9\tfrac{7}{8} = 240 : \frac{79}{8} = \frac{240 \times 8}{79} = \frac{1{,}920}{79} = 24{,}30$$

El valor de la libra es $24,30.

3) Averigüemos el valor del dóllar en moneda chilena.

Regla.—Para encontrar el valor del dóllar en moneda chilena, se divide a 50 por el cambio dado sobre Londres.

Un dóllar al cambio de 9 siete octavos ¿cuánto vale?

$$50 : 9\tfrac{7}{8} = 50 : \frac{79}{8} = \frac{50 \times 8}{79} = \frac{400}{79} = 5{,}06$$

El valor del dóllar es 5,06.

4) Nos queda que determinar el valor del franco en moneda chilena.

Regla.—Para saber el valor del franco en moneda chilena, conociendo el cambio sobre Londres, se determina primero el valor de la libra esterlina, el resultado se multiplica por 4 y el producto se divide por 100.

Un franco, al cambio de 9 siete octavos, ¿cuánto vale?

Ya sabemos que la libra esterlina vale $24,30.

24.30 x 4 =97,20

97,20 : 100 =0,97.

El valor de un franco entonces es $0.97.

Con estas operaciones, nos es muy fácil llegar a la conclusión de nuestro problema.

I. Un marco vale $1,20; 15,000 valdrán 15.000 x 1,20 =18,000.00.

II. Una libra esterlina vale $24,30; 720 libras esterlinas valdrán 720 x 24,30 =$17,496.00.

III. Un dóllar vale $5.06; 3,400 valdrán 3,400 x 5,06 =17,204.00.

IV. Un franco vale $0,97; 18,000 valdrán 18,000 x 0,97 =17,460.00.

Tenemos entonces los precios siguientes:

En Hamburgo cuesta $18,000.00.

En Londres cuesta $17,496.00.

En Estados Unidos $17,204.00.

En Francia $17,460.00.

Nos conviene comprarla en Estados Unidos, que es donde cuesta más barato.

Problemas sobre pertenencias mineras

Dada la superficie de una pertenencia minera y un lado, determinar el otro.

Ejemplo.—Queremos medir una pertenencia de tres hectáreas, o sean 30,000 metros cuadrados. Deseamos darle al Norte 100 metros, al Sur 60 metros. ¿Cuántos metros debe tener el otro lado?

El lado que se nos da va a tener 160 metros.

Regla.—Cuando se da la superficie de un rectángulo y un lado, y se desea saber el otro, basta dividir a ésta por el lado conocido; el cuociente nos dará el otro lado.

En el ejemplo dado dividiremos a 30,000 por 160.

30,000 : 160 =187,50. Deberá tener 187,50 metros.

Equivalencias de hectáreas en metros cuadrados

1	hectárea	= 10,000	metros	cuadrados.
2	„	= 20,000	„	„
3	„	= 30,000	„	„
4	„	= 40,000	„	„
5	„	= 50,000	„	„

Problema para determinar el valor del mineral extraído de una internación:

Antes de entrar al problema daré una idea de lo que se llama peso específico de un cuerpo.

Los cuerpos de la naturaleza, por lo general, tomados en volúmenes iguales, no tienen el mismo peso.

Para tener una idea más precisa de los pesos específicos de los cuerpos, se han referido todos a un mismo cuerpo, que es el agua a 4 grados sobre cero, tomados bajo el mismo volumen.

Densidad o peso específico de un cuerpo, es el cuociente del peso de una cantidad cualquiera de este cuerpo, dividido por el peso de un volumen igual de agua.

Ejemplo.—Una masa pesa 25 kilos, y el mismo volumen de agua pesa 4 kilos; la densidad será 25 : 4 =6,25. Este sería el peso específico o densidad del cuerpo.

Vamos ahora a entrar a resolver un problema sobre las internaciones.

La internación de la mina Centenario ha sido de 22,65 mt. de largo; 1,43 mt. de ancho medio, y 2,09 mt. de alto

Las leyes tomadas en diferentes puntos han dado 15, 12, 15, 16 y 18,2 por ciento.

El peso específico del mineral ha sido de 5,7.

Se pregunta el valor del mineral extraído, sabiendo que el 10 por ciento lo han pagado a $8.50, con escala de subida de $0.85, y de bajada de $0.95.

Solución.— Lo primero que haremos será determinar los metros cúbicos de mineral, multiplicando el largo por el alto y por el ancho.

22,65 x 2,09 =47,3385

47,3385 x 1,43 =67,694055 mt. cúbicos.

Pasemos en seguida a determinar el peso del mineral, es decir, de los 67.694,055 metros cúbicos. Para esto, sabemos que el peso específico es de 5,7

De esto deducimos que el metro cúbico del mineral pesa 57,00 qq. mt. Ahora los 67.694,055 pesarán 67.694,055 x 57 =3,858.561,135 qq. mt.

Se nos presenta nuevamente el problema que ya hemos estudiado, y que es:

3,858.56 qq. mt. de mineral de ley de 14,8 por ciento (esta ley la determinamos sacando el término medio entre 15, 12, 15,16 y 18,2 por ciento), y sabemos que el 10 por ciento lo pagan a $8.50, con escala de subida de $0.85.

8,50 4,87 x 0,85=4,1395

\+ 4,14 3858,561 x 12,64=$48772,21104

$ 12,64

Problema para determinar el precio del 10 por ciento de minerales de cobre, sabiendo el valor de la barra y una base dada.

Ejemplo.— La barra de $113.00. Base, 24.

Esta base de 24 se refiere a un qq. esp. de 46 kilos y la barra a un qq. mt. Por lo tanto, hay que resolver una proporción para sacar el precio de los 46 kilos.

100 : 113 :: 46 : x

$x = \frac{113 \times 46}{100}$ = $51,98 el qq. esp.

De este resultado 51,98 se le resta la base, que es 24, para saber cuántas unidades o pesos de más tenemos, porque por poca unidad nos abonan $0.15.

51,98—24=27,98.

A estos 27,98 se multiplica por $0.15, y a este resultado se le agregan $2.00, que es el precio que pagan en Valparaíso por el qq. mt. con cualquiera base.

27,98 x 0.15 =$4,197.

$4,197 + $2.00 =$6,197.

Ahora, para determinar la escala que corresponde a este precio (del 10 por ciento) se divide a 6,197 por 10, y se le agregan $0.10, y esta es la escala de subida, y la de bajada es $0.10 más que la de subida.

DATOS PRACTICOS

Superficies.

La superficie de un triángulo rectángulo es igual a la mitad del producto que resulta de multiplicar los dos catetos entre sí.

La superficie de un triángulo cualquiera es igual a la mitad del producto que resulta de multiplicar la altura por su base.

La superficie de un trapecio es igual a la semisuma de las bases por su altura

La superficie de un círculo es igual al producto del radio multiplicado por sí mismo, y éste, a su vez, multiplicado por 3,1416.

Superficie de un sector circular es igual a la mitad del producto del radio por el arco que le sirve de base.

La superficie de un prisma, multiplíquese el perímetro de la base por la arista lateral del prisma.

La superficie curva de un cono recto, multiplíquese el contorno de su base por la mitad de su arista.

La superficie de una esfera, multiplíquese 3,1416 por el cuadrado de su diámetro.

Volúmenes

Volumen de un prisma cualquiera, multiplíquese el área de su base por su altura.

Volumen de una pirámide, multiplíquese el área de su base por el tercio de la altura de la pirámide.

Volumen de un cilindro, multiplíquese el área de su base por su altura.

Volumen de un cono, multiplíquese el área de su base por el tercio de su altura.

Volumen de una esfera, multiplíquese el cubo del diámetro por 0,5236.

Temperatura de fusión de algunos cuerpos

Platino	2,500°
Hierro	1,600°
Acero	1,400°
Oro	1,250°
Cobre	1,200°
Plata	1,000°
Bronce	900°
Antimonio	432
Zinc	360°
Plomo	333
Bismuto	366
Estaño	230
Azufre	109
Sodio	90°
Potasio	58°

Depósitos de Gases y Petróleos.

El estudio para la clasificación de los terrenos en los cuales se cree encontrar ya petróleo o gas, es, en verdad, un tanto diverso a los dos métodos empleados ya, geológicos o económicos, en la clasificación de los terrenos carboníferos, u otros que contengan substancias minerales de carácter estable.

La clasificación de los terrenos petrolíferos o de hidrocarburos, exige, sin embargo, un detenido estudio del terreno en el cual se deben acumular todos los detalles, los cuales se han de comparar a los ya conocidos principios geológicos y científicos en que se prueban con gran exactitud la existencia de los hidrocarburos en el mundo.

Aunque, sin duda alguna, el taladro ha sido el que generalmente ha demostrado al industrial o explorador la existencia de tan rica substancia, ya por hechos casuales o por ligeras apreciaciones, sin embargo, la aplicación de los principios geológicos aplicados a los terrenos que reunen semejanzas a otros conocidos, servirá para determinar si hay o no la substancia buscada, en condiciones que la ha de hacer considerar como negocio industrial.

En el estudio de los terrenos petrolíferos y de sus probables yacimientos de hidrocarburos, se debe tener presente que el petróleo y gas son substancias movibles, y que debido a esa particularidad, como también a su gravitación, presión hidrostática y capilaridad, es necesario variar los métodos de estudio de los empleados en terrenos carboníferos u otros con materias estables. La inestabilidad del petróleo ha causado en muchas regiones ricas en un tiempo en dichos productos, emigrar a otros lugares a través de gruesas capas de estratas permeables, hasta llegar a sus actuales locaciones.

La actual posición de estos depósitos dependen principalmente en el carácter de las estratas, la estructura de las rocas, la presencia o ausencia de agua, y del carácter y peso específico del petróleo.

Los hidrocarburos líquidos no se les encuentra, como algunos lo suponen, en depósitos subterráneos, como un lago o un **reservoir** rodeado de rocas, sino que existen en rocas porosas que se saturan con estos hidrocarburos, y en donde las estructuras geológicas, las condiciones acuosas subterráneas y la sucesión de las estratas son tales, que las acumulaciones petrolíferas son encerradas por rocas de carácter impermeable. La estratificaciones porosas, en donde los hidrocarburos se depositan, son a menudo denominadas como "arenas petrolífera," aunque en realidad no lo sean, pues sucede a veces que son "areniscas," "arcillas," "calcáreas," o aun una zona de rocas fracturadas.

Las acumulaciones petrolíferas en los Estados Unidos, se pueden dividir en tres clases: 1a. Aquellas que ocurren en estratas de areniscas o calcáreas, entre capas de rocas relativamente permeables al aceite. Las areniscas o calcáreas pueden ser de una gran extensión, o de una área insignificante. En algunos lugares comprenden sólo pequeños depósitos de un material poroso, embebido en características rocas permeables; pero en otros sitios ocupan cientos de millas cuadradas de capas muy regulares. A esta formación pertenecen casi la mayor parte de los yacimientos petrolíferos en Norte América. 2a. Aquellas que ocurren en estratas porosas aparentemente lenticulares. 3a. Aquellas que aparecen en las fisuras de las pizarras.

Las fracturas de otras rocas, como calizas y areniscas, ofrecen favorables condiciones para las acumulaciones de aceites minerales; pero las areniscas, y bajo ciertas condiciones las calcáreas, son capaces de almacenar petróleo sin estar fracturadas. La fracturación solamente aumenta la capacidad del yacimiento o depósito. Una pizarra de grano fino, aunque capaz de acumular aceites, no le permite a éste correr a través de las rocas con la suficiente velocidad para una acumulación en el fondo de un pozo, a no ser que estas pizarras estén fracturadas o quebradas, en las cuales sus uniones hacen las veces de canales para la lenta emigración del petróleo.

Se debe establecer como un principio fundamental, que las acumulaciones de hidrocarburos, ya líquidos o gaseosos, sólo se les encuentra en rocas estratificadas o sedimentarias. En regiones en donde la estratificación ha sido alterada por rocas eruptivas, son por regla general desfavorables a los almacenamientos de petróleos, si se consideran las altas temperaturas y cambios que se originaron, accidentes éstos que habrían tenido desastrosas consecuencias en materias volátiles como las descritas.

En general, todos los hidrocarburos se encuentran en estratas sedimentarias, de grandes o pequeñas extensiones, pero regulares. Estas estratas fueron originadas y depositadas por el agua, en el Océano, en lagos de agua dulce, en grandes desembocaduras de ríos o deltas, prácticamente al nivel del mar, en capas más o menos horizontales. Una vez que los sedimentos que formaron esta sucesión de mantos se sacaron y tomaron la dureza que caracteriza a las areniscas, calcáreas y pizarras, sucedió que en ciertas áreas fueron alteradas por fenómenos geológicos, resultando con esto la formación de ondulaciones de diferentes formas y extensiones, en cuyas ondulaciones o dobleces es precisamente adonde se encuentra el petróleo.

De cualquiera de los factores que contribuyen a probar la existencia de los hidrocarburos, ninguno es de mayor importancia que el papel que desempeña la **estructura** de la roca. La actitud en que yacen los mantos, la forma de las ondulaciones o dobleces de éstos y la presencia de fallas o quebraduras en las estratas, es lo que constituye la estructura de las rocas.

El contenido líquido de las capas porosas obedece a las leyes de la gravitación y capilaridad, separándose y distribuyéndose entre ellos de acuerdo con sus pesos específicos.

Si agua, petróleo y gas existen mezclados en capas petrolíferas, el gas se desprendería lo más que le fuera posible de los líquidos para subir y acumularse en el punto más alto del doblez de la capa que lo encierra; mientras tanto, el agua se desprendería del petróleo para depositarse en la más inferior de las capas permeables en que descansan.

Si el manto es inclinado y el agua se encuentra bajo una presión artesiana, naturalmente que ésta buscará su salida hacia arriba, manteniendo en su ascenso al petróleo sobre ella, debido a su diferencia específica; así también, si la capa que encierra estos hidrocarburos es porosa, y su porosidad es inalterable hasta su afloramiento, el gas y el petróleo se presentarán en la superficie como filtraciones o emanaciones. Si todavía el progreso de los hidrocarburos hacia arriba es detenido por un doblez de una capa superior o por una falla, la cual cerraría en vez de abrir la estratificación, o aún más, por una saturación de la capa, debido a la existencia de agua, y un depósito de hidrocarburos tuviera lugar, el aceite y el gas permanecerían entre el agua, y cualquier otro fenómeno que les impidiera su ascenso hacia el exterior. Esta teoría, que es conocida con el nombre de "Teoría de la Anticlinal," es prácticamente aceptada y conocida por los geólogos que a estos estudios se han dedicado

Si la roca que contiene el petróleo no acarrea en su interior agua, naturalmente que no habría fuerza que obligara al aceite a ascender hacia arriba de la anticlinal; por el contrario, su propio peso lo obligaría a acumularse en la parte más baja de una sinclinal. Este último caso es muy frecuente en los yacimientos petrolíferos de Pensylvania.

Hay casos en que la emigración del petróleo de entre las capas que lo cubren se debe a la presión de gases semifluidos o absorbentes en ausencia del agua, y que obliga a éste a moverse en todas direcciones, hasta encontrar una capa impermeable en la que se deposita, sin tomar en cuenta aparentemente la estructura de la roca.

La mejor y más favorable de las estructuras para las acumulaciones de petróleos es aquella que contiene simétricas anticlinales, con pequeña o ninguna inclinación de sus ejes y moderada caida en sus flancos.

Es evidente y se ha comprobado en muchos casos, que la extensión de las zonas productivas de hidrocarburos controladas por una estructura anticlinal, es mayor donde los dobleces de las capas son extensos y las inclinaciones de las estratas son pequeñas, que cuando los dobleces son estrechos y con incli-

naciones muy pronunciadas en sus costados, debido a que en el primer caso el lugar que se forma para el almacenamiento es mucho mayor que en el segundo caso.

Estructuras características de otros tipos, son en ciertas localidades favorables a las acumulaciones de hidrocarburo, ya líquidos o gaseosos.

Entre éstas se pueden mencionar las "monoclínicas," las cuales presentan condiciones ventajosas a las aglomeraciones de hidrocarburos en parte donde existe un cambio en la inclinación de las rocas o un cambio brusco de los mantos.

En zonas petrolíferas que carecen de aguas subterráneas y con superficies sinclinales; en sinclinales en donde el agua y el petróleo acumulado tienen más o menos el mismo peso específico, son también favorables a los yacimientos de petróleos.

Las fallas son generalmente consideradas como deplorables a los almacenamientos de petróleos y gases, y en zonas donde las dislocaciones del terreno son numerosas, esta teoría ha sido siempre correcta. Sin embargo, en algunos lugares, esta teoría en contra de las fallas ha probado lo contrario. Por ejemplo, una falla puede causar un gran almacenamiento de petróleos hacia las crestas de un doblez; así mismo, una serie de fallas con grandes declives en un terreno con numerosas capas de "arenas" petrolíferas, pueden obrar en un sentido muy favorable, debido a que comunican varias de estas capas petrolíferas, las cuales vendrían a aumentar en grandes proporciones la producción o almacenamiento de una de las capas comunicadas.

En muchos terrenos se ve poco o nada que pueda indicar la existencia de los hidrocarburos al explorador; pero en muchos otros campos existen amplias manifestaciones de ellas en la superficie. Existen estratas petrolíferas que afloran a la superficie y el petróleo se nota a la simple vista como se escurre sobre las capas o rocas adyacentes, dándoles a estas últimas un color gris obscuro y grasiento, e impregnado de un fuerte olor a parafina. También puede el petróleo encontrar su camino hacia arriba del afloramiento, debido a una fractura de la roca superior. Las aguas mezcladas con diferentes sales y azufres pueden también acarrear el petróleo, tomando un color irísio grasiento, una vez que se depositan, seña muy característica de la presencia de los hidrocarburos en el interior.

En los lugares donde el petróleo ha alcanzado la superficie y donde ha sido evaporado por la acción del sol por un largo período, son señalados por la presencia de asfaltos. En algunas localidades, las pizarras petrolíferas han sido calentadas hasta un rojo ladrillo, o alteradas hasta formar una masa dura vesicular, lo que las hace aparecer como una lava volcánica. Este metamorfesismo es debido a la ignición de los hidrocarburos, que habían impregnado las pizarras; por consiguiente, la presencia de tales rocas es un dato de gran aliento y muy importante. Los gases pueden aparecer en la superficie como reflujos de un volcán o de una fuente termal.

La existencia de estratigráficas formaciones con yacimientos de hidrocarburos ya sólidos, líquidos o gaseosos, existen en los Estados Unidos en más o menos abundancia a través de las capas del período Cambriano, hasta las estratas más modernas del Terciario.

En la región comprendida a lo largo de las "Montañas Rocosas" (continuación de los Andes), los depósitos de hidrocarburos yacen en una formación que comprende desde las últimas capas del Paleozoico hasta las últimas del Mezozoico. En la parte comprendida por la Baja California y Nuevo México, la explotación de aceites minerales se encuentra exclusivamente en las capas del período Cretáceo. En la costa del Pacífico, los yacimientos petrolíferos se les encuentra principalmente entre las rocas Cenozoicas, aunque también se les encuentra en el Mesozoico. La formación californiana se le considera como Terciaria, y varía en edades desde el Mioceno hasta el Plioceno.

A pesar de esta larga enumeración de formaciones, en las cuales se ha encontrado ya en escasas o colosales proporciones, hidrocarburos en estado sólido, líquido o gaseoso, no hay por esto que hacerse la ilusión de que estas substancias minerales en cualquiera de los Estados mencionados se les ha de encontrar en todas las zonas donde existen rocas sedimentarias, pues estos depósitos sólo se conciben en formaciones que reunen especiales condiciones adecuadas para un almacenamiento, y por último, en favorables estructuras.

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* Escrito por el señor César Zelaya, en el Boletín de la Sociedad Nacional de Minería.

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On Saying the Thing Which is Not.

The ancient worthy who remarked, "I said in my haste all men are liars," probably had in mind some such condition as we have been experiencing in the capital city of Mexico while the present issue of the Journal was in preparation. And there was no call for haste: many quoted his sage observation quite calmly and at leisure. Those superior persons among us who are fond of complaining about the inaccuracy of modern journalism, knowing that we ought to believe only about twenty-five per cent of the reports printed in the best of the great dailies, have come to have fresh respect for the makers of the saffron sheets. The gentlemen of the yellow press really deserve great credit for producing that surprisingly large proportion of truth, for of all reports available here during the past month not more than one per cent could have been true and even these seemed off color.

All of which goes to show how difficult a thing it is to tell the truth, if, as a matter of fact, any conception of the human brain can be absolutely true, which G. B. Shaw denies. For it must not be supposed that all of the wild reports about movements, international and parochial, which were to affect us poor foreigners, were deliberately invented in order to deceive some or all of us. Some indeed had that flavor, comparing rather favorably with the usual official utterances from abroad, but most of them were too silly to show signs of any deliberate design. Most of these curious rumors were hawked about by people who really believed them, or wished to believe them, which is very much the same thing. The ancient worthy quoted above should himself have been more truthful, and instead of calling all men liars, should have said, "all men miss the truth by about two miles."

What we call truths, even in our most accurate measurements, are only approximations, and it requires careful training to make a fairly decent approximation. The routine manipulations of an assayer are simple enough, but to know just when to doubt or to accept one's own results or to keep one's judgment from supplementing the swing of the balance requires training and a high degree of integrity. The engineer's transit represents in mining camps everything that is accurate, yet everyone who has fingered its adjusting screws knows how difficult it is to make that transit live up to its reputation.

Truth is after all only a human ideal, and like all the higher ideals, is beyond the average reach.

Leaching and Flotation.

During the past few years much original research work has been done on the recovery of copper from low grade material by wet methods, chiefly leaching with acid solutions. One great difficulty encountered in

the use of such solutions is due to the fact that they quickly become fouled with compounds which it would be more desirable to leave undissolved. Acids that attack minerals of copper also dissolve many other minerals and compounds. Considerable progress has been made in overcoming this difficulty, yet success along these lines will always depend largely upon the character of the gangue minerals in the tailings treated. The solution of copper can never be made the selective process that has made cyaniding what it is today.

Much progress has also been made in increasing the economy of precipitating copper from weak solutions by electrolytic means. Yet one of the largest installations for the recovery of copper by leaching is equipped to recover in the old way, precipitation upon metallic iron. The cost of current still continues to forbid the use of many pretty electrochemical proceses everywhere.

All copper leaching methods have the further disadvantage that in most cases they must be preceded by a roasting operation, and in low-grade material this is a serious matter, for 100 per cent of rock must be raised to roasting temperature for the benefit of, perhaps, one per cent of recoverable metal. Moreover, leaching with acid solutions does not save the gold and silver, the presence of which even to the value of only a few cents per ton is so important in the metallurgy of copper.

Flotation, on the other hand, involves no heat treatmen until the waste minerals are eliminated, and the concentrated metallic minerals carry with them the gold and silver. Many of the complications formerly associated with flotation processes have been got rid of, but unfortunately that of patent litigation still remains. Time will heal that sore as it does most of the evils under the sun, and surface tension as a basis for mineral separation will undoubtedly take its place in concentration beside specific gravity. Let us hope that this perfectly simple principle of physics will not give rise to the multiplicity of mechanical complications that we owe to the equally simple relation of mass and volume. If the introduction of flotation is to double the number of concentrating contraptions now on the market its advent will not be an unmixed blessing.

New Ideas on the Origin of Ore Deposits.

Of opinions on the subject of why ores happen to be where they are there will never be a lack so long as the human tendency to conjecture about things that can never be proved persists. Recently there seems to have been less disagreement among the authorities than formerly, but in the nature of things it is to be hoped that entire agreement will never be achieved. Among the more recent discussions is one that, if it were not entirely theoretical, might concern the mining fraternity rather seriously. The discussion was about the persistence of values in depth, and during its progress T. A. Rickard marshalled an array of solid facts to prove that "all ore deposits, in spite of downward continuity of favorable structure, tend to impoverish in depth."

This is a remarkable example of British courage, for it would be hard to find a more unpopular statement than that. To rob mining of the hope of "better ore lower down," is to rob it of its most powerful incentive, and to rob the classic mining prospectus of its only, solitary argument. Fortunately for mining there are many authorities that do not agree with this revolutionary opinion, and at least one long article has been written to prove that certain veins of the Mother Lode of California "will hold their gold tenor down to the lower limits of practicable mining."

During the past year there has been a lively discussion about the original of the garnet zones and associated ore deposit that occur at the contact of limestone and intrusive granitic rocks. In this discussion no agreement is likely to be reached for some time, the arguments of those who favor the recrystallization hypothesis having apparently no effect upon their opponents.

The doctrine of magmatic waters has been attacked rather vigorously in a paper intended to prove that much of the argument in favor of magmatic waters can be applied with equal force to the hypothesis of meteoric water and that the problems of the orign of contact-metamorphic deposits still remain to be solved.

Conservatism and Progress.

It has been claimed that an art or an industry owes more to the conservatives who are always reluctant to recognize any change than to the progressives who are eternally trying to introduce something new. That may be true or not according to the point of view. To the conservative it is more comfortable to sit still than to move. It is unfortunate for the progressives that the conservatives are always in an overwhelming majorty. It takes a tremendous push to start anything really new and not merely an improvement.

Some years ago a young engineer conceived the brilliant idea of pumping the solid deposits of sulphur in Lousiana instead of mining them in the usual way. The melting point of sulphur is sufficiently low to permit of its being liquified by means of steam introduced through pipes driven from the surface. Everyone knows of the early trials and disappointments which Frasch had to face, and the solid weight of conservatism which he was compelled to move. Yet the final result of his efforts upset the world's market. The conservatives in Italy who had for years controlled the market are probably still wondering what happened to them.

It was a young man almost fresh from college that perfected the process for making cyanide by synthesis instead of the time honored method of working up various by-products. The inventor of the first practical process for the manufacture of aluminum and later other electric heat processes was also young and undiscouraged.

None of these revolutionary inventions owes anything to the conservative elements in the industries which they revolutionized. The risks of failure seemed too great to those to whom success had brought the dread of failure. However, of late years the world's attitude towards the new has changed. While the aim

of all business is still to play safe and avoid risks, it has been found that the biggest profits sometimes elude the conservative. The development of new processes and new systems is no longer left to the young and inexperienced. Edison has taught the world to reject nothing that promises to serve a given purpose until it has been tried and found wanting. Manufacturers of electrical machinery find that it pays better to give inventors a salary than to buy their inventions or to beat their patents by process of law.

In some industries the quest of the new has even been organized and systematized until the element of chance has entirely disappeared from the process of invention. The production of new dye compounds has been reduced to a routine, and in many cases it is possible to predict what the result of a new combination of radicals is likely to be. Haphazard, chance invention is being replaced by organized research. The U. S. Department of Agriculture is merely a vast research organization for the benefit of a single industry, and its chief function is to teach research to the individual. Some day no large industrial establishment will think of doing business without a research organization. It will be as indispensable as the system of accounting.

And yet the average mining company calmly ignores nearly all the unknown physical and chemical facts which are essential to its very existence.

Colonel Tepetate.

"Things are not what they used to be," sighed the Pessimist.

"No. They are not," admitted Col. Tepetate. "The soft pickings have been growing scarcer for a long time. I wonder what has become of all the smooth gentlemen who used to live by their wits. When perfectly legitimate schemes can't excite the wink of an eyelash, what chance has a shady enterprise? By the way, where are all the sharpers during these hard times? It can't be that they have all turned honest."

"They'll come out of their holes thick enough when the sun shines again."

"Sure! But I wonder where they get their frijoles in the mean time. Boom times are their season of harvest. They haven't pulled off anything for so long that they must be getting rather lean."

"What do you know about fake mining schemes?"

"Enough."

"You don't mean to say that you were personally mixed up with that crowd."

The old gentleman smiled and nodded slowly. "It was perfectly innocent on my part, but I did help bamboozle a lot of lamb stockolders once upon a time."

"You ought to be ashamed of yourself."

"I am. It happened this way. Times were booming, but I was out of a jeb. You know it is sometimes harder to keep in jobs in flush times than in seasons when everybody counts his cartones five times a day. I was out of a job and feeling rather blue. Everybody else was so busy that I couldn't find any body to talk to."

The Pessimist nodded. "I know that feeling," he said.

"One morning I was finishing my huevos rancheros, when a round little man came in and said he wanted a man to run a smelter. He wore a white vest with gold chains enough to anchor a ship. With a plug hat cocked at an insulting angle and an enormous cigar with a two-inch gilt life preserver, he fairly oozed prosperity.

"I intimated modestly that I was a practical smelter and would be glad to tie up with something solid. He coughed a little and said that he needed a man for only two weeks but thathe would pay in advance. He named a smelter in some little hole in the mountains that I had never neard of. But, as I said before, I was out of a job, and I was interested to know what sort of an outfit he had hidden away. So I packed up and went with him.

"I need not tell you where it was or how we got there. I noticed that most of our baggage consisted of champagne and other liquids, but I had no particular objection to that. The smelter was one of those coffee-pot affairs that you see illustrated in the catalogues, supplied all ready to run, no need of any engineer except the man at the drawing board in the factory office. My new boss asked me rather anxiously if I could run it. I said, Sure: but where is your ore?

"You see, I had been looking around and had found nothing but a pile of coke and a heap of country rock. My question did not disturb him in the least. He asked me what I needed. I said since it was a lead furnace I ought to have some lead ore to start with. But it seems there was no lead ore any where within hundreds of miles, and the boss seemed disappointed that I was going to expect the impossible. He insinuated that since I was an expert I ought to be able to run without lead ore. I remarked that if he merely wanted to see the wheels go round I thought I could find something to make into slag if not matte.

"That delighted him. Certainly, quite right, of course. He merely wanted to see if the plant was all right. He gave me all the peons on the place and turned me loose, cautioning me not to start up until I had given him three days notice. I poked around in the hole in the ground, that was capitalized as a mine, and found nothing but a little string of pyrite that hadn't a smell of anything but iron and sulphur. I collected a few tons of that and got a few loads of lime rock out of the arroyo, and told him I was ready to begin.

"The president and general manager of that fabulously rich mine held me up for a week. Finally he got a telegram and started off to the station and instructed me to get overything ready and start up the next morning so as to be in full blast by the time he returned.

"Of course I didn't bother about economical slags. I made sure to have it fluid enough. The next day I had just pulled the first pot of slag and was showing the peons how to fix a mud tapon, when in sailed my boss, all togged up in silk hat and Prince Albert, followed by a dozen innocent boobs, who had evidently been kind enough to furnish the money. He strutted around, blowing about a going concern, annihilating doubting Thomases, and all the rest of that old dope. When I ran a rod into the tap-hole and a fine hot stream of stuff spattered into the slag pot—I never knew

whether it had any matte or not—you should have seen him swell up. And those poor boobs. Their eyes fairly stuck out of their pink faces.

"The boss came sliding around to me and asked if I could keep it up for an hour or two. I made him easy on that score, and then he carted his victims to the house and I suppose pulled corks. He herded them carefully so that none of them got a chance to ask me any questions, for which I was not at all sorry. In the afternoon they all got away in fine style and the boss came riding back, ostensibly to give me additional instructions. He told me I had done nobly and to shut her down as soon as his party had turned the mountain out of earshot of the blower."

"And you never showed him up?" demanded the Pessimist.

"How could I? I left the next day and never saw him or his crowd again."

"And the smelter?"

The old gentleman hoisted his shoulders. "I suppose it has rusted away by this time. There are hundreds of them all over this country and the States as well. There probably always will be more mills than mines. Human nature is that way."

Tin Mining Conditions in Bolivia

Written for the Mexican Mining Journal.

BY FRANCIS CHURCH LINCOLN. *

I. History and Production.

Tin mining is a comparatively recent industry in Bolivia. It is true that during the Inca Period some bronze objects were manufactured by the Indians, but the tin content of these articles is very variable, and it is probable that the bronze was obtained by smelting stanniferous copper ore rather than that the tin and copper were mined and reduced separately and afterwards alloyed. The Spanish conquerors in their search for silver prospected many of the tin veins at present in exploitation and worked a large number of them for their silver contents, leaving the tin in the mines or on the dumps because of its low value.

In the early days of the Bolivian Republic, silver was also mined in preference to tin, but a great change has come about in recent years, and the ancient silver mines and dumps are now being worked for tin to the great profit of their owners. Four things have given impetus to the recent phenomenal rise of tin mining in Bolivia:—the exhaustion of the silver bonanzas, the discovery of new and rich tin deposits, the decrease in price of silver, and the increase in price of tin. For these reasons, the silver miners have turned their attention to tin mining, and silver has become little more than a bye-product of tin production.

The tin production of Bolivia in 1846 was 600 metric tons per year. It increased slowly till it reached 3,000 tons in 1898, having multiplied 5 times in 52 years. In the succeeding 14 years, the tin production of Bolivia multiplied more than 8 times, or about 5 times as fast as in the preceding period. Thus the history of tin mining in Bolivia is practically confined to the last 15 years.

Bolivia is today the second tin producing country of the world and the first tin lode mining country. She produces about one-fifth of the world's supply of tin, her production being only exceeded by that of the Straits Settlements and Malay Peninsula. As the production of this latter country is mainly from placers, while Bolivia's production is mainly from lodes, her pre-eminence as a tin lode mining country is evident.

II. Geography.

Just north of Lake Titicaca in southern Peru the great mountain chain of the Andes branches into the "Cordillera Real," or Main Range, and the "Cordillera Occidental," or Western Range. These two ranges pass on opposite sides of Lake Titicaca into Bolivian territory and continue roughly parallel till they reach southern Bolivia when they come together once more on the Argentine boundary. Thus they form a great irregular ellipse with vertices in Peru and Argentina,-650 miles apart,- and a smaller diameter in Bolivia of 150 miles. Within this ellipse is the high plateau of Bolivia, averaging some 12,500 feet above sea-level. The tin deposits occur in the Main Range of the Andes and on the Bolivian Plateau immediately to the west of it.

Bolivia is an inland country entirely dependent upon her neighbors for outlets to the sea. An examination of the railway map of Bolivia, shows that La Paz is the railway center of Bolivia and that 3 railway lines are in operation from that city to the coast. La Paz is connected with the port of Mollendo, Peru,—distant 1158 kilometers,—by the Guaqui-La Paz RR., boats on Lake Titicaca, and the Southern RR. of Peru. Arica, Chile, is 447 kilometers from La Paz by the Arica-La Paz RR.; and Antofagasta, Chile, 861 kilometers by the Antofagasta-Bolivia RR. Notwithstanding these 3 supposedly competing railway lines, the freight rates on machinery and supplies needed for the tin mines and the ore and concentrates exported by them are exorbitantly high. Many of the mines are not situated on the railroad and must ship their products out and their supplies in on llama-back, mule-back, or in carts drawn by mules. The Bolivian Plateau is well-supplied with fair cart roads, but these rarely extend but a short distance into the Main Range where most of the mines are situated so that transportation is necessarily largely upon the backs of animals. Llamas cost about $15 apiece, find their own feed along the trail, and carry loads ranging from 50 to 100 pounds. Mules carry from 200 to 400 pounds, cost from $30 to $50, and require special feeding. The load a cart will carry varies greatly with the road, great difficulty being experienced in hauling even an empty cart on some of the roads. Transportation by mule-back or cart is quicker than llama transportation but costs more. Where the cart can be used, it has the advantage of being able to handle large pieces whole which otherwise would have to be sectionalized. In figures 3 and 4, pack train of llamas and mules bound for the mines are shown.

Llamas Transporting Mining Supplies in Bolivia

All of the mines of Bolivia are situated at high altitudes. There are two seasons, the rainy or summer season from November to March, and the dry or winter season from April to October. The total rainfall is only about 30 inches per year, and this does not all fall during the rainy season as there are occasional rains throughout the dry season. It is cool all the year, the difference in temperature between seasons not being great. The climate of those mines situated on the Bo-

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livian Plateau or at elevations not greatly exceeding that is good, but the climate of the mines at elevations of 15,000 feet and more in the Main Range is very bad because of wind, cold, hail and snow. The altitude of even the lower mines seriously affects the comfort of most foreigners and prevents their exerting as great a mental or physical effort as they are capable of at lower elevations.

Mules Transporting Milling Machinery.

The tin deposits of Bolivia begin at Carabuco on the shore of Lake Titicaca on the northwest and extend southeasterly following the general trend of the Main Range of the Andes for 400 miles to Portugalete not far from the Argentine border on the southeast. They do not form one continuous belt, but a series of groups arranged roughly in line. The most important groups are those of Huayna-Potosí, Quimsa Cruz, Oruro, Potosi and Chorolque. The places where tin has been found are shown in Table I. Mines are not working in all the localities named, but the table serves well to show the wide distribution of known tin deposits in Bolivia. Several promising areas of considerable size have never even been prospected.

TABLE I DISTRIBUTION OF BOLIVIAN TIN DEPOSITS.

La Paz.

Carabuco, Sorata, Huayna-Potosí, Milluni, Chacaltaya, Araca, Quimsa Cruz, Quime, Inquisivi, Sayaquira, Sicasica, Luribay, Yaco, Jehoca, Mohora, Peñas, Capiñata, Ayoayo, Achiri, Berenguela.

Oruro.

Colquiri, Oruro, Negro Pabellón, Morococala, Machacamarca, Poopo, Antequera, Totoral, Avicaya, Bizacoma, Carangas, Ichocollo, Challapata, Huanuni.

Potosí.

Uncia, Llallagua, Amaya, Amayapampa, Moscari, Sacaca, Acero Cruz, Río Blanco, Pocoata, Macha, Moromoro, Tacarani, Chairapata, Chayala, Panacachi, Tinguipaya, Tarapaya, Yocalla, Chulchucani, Chaviri, Manquiri, San Benito, Concepción, San Pedro, Chorolque, Esmoraca, Suipacha, Estarca, Portugalete, Coroma, Porco, Tolapampa, Tomave, Machacamarca, Siporo, Caiza, San Pablo, Tasna, Potosí, Huari-Huari, Colavi, Puna, Tarapaya Santa Isabel, Ocuri, Maragua, Sillama, Chaqui, Tacobamba, Aullagas, Colquechaca, Coripuyo, Cotagaita, Cerro Rico, Karikari, Ayoma, Pulacayo, Huanchaca, Suipacha.

Cochabamba.

Quirquiavi, Charapaya, Morochata, Arque, Tacopaya, Berenguela, Colcha, Sicaya, Cocapata ,Ayopaya.

Chuquisaca.

Tomina, Padilla, Yamparaez.

III. Geology and Mineralogy.

The Main Range of the Andes has a granitic core which has been exposed in some localities, especially in the highest peaks as a result of profound glacial erosion. Upon the granitic rock rest Paleozoic slates, schists and quartzites belonging to the Ordovician, Silurian and Devonian series; and upon these lie unconformably red and white sandstones probably of Mesozoic age. The scarcity of fossils in all save the Devonian rocks renders the determination of the geologic ages of the different formations extremely difficult. The tin deposits occur in the eruptive rock and in the Paleozoic sediments. These sediments were laid down under water in an approximately horizontal position and were later tilted, folded, and dislocated at the time of the formation of the Main Range. The granitic rock was also intruded at this time in the form of a huge batholith or series of batholiths with porphyritic apophyses. Exhalations from the cooling igneous rock produced the tin deposits. The Mesozoic sediments were also laid down in an approximately horizontal position, but under desert conditions. They have since been subjected to tilting, folding and dislocation, possibly when the Western Range was formed,—but are not disturbed to the same extent as the Paleozoic rocks.

Finally immense glaciers covered the whole of the tin region. They eroded the Mesozoic rocks exposing the tin lodes and also wore away parts of the Paleozoic and igneous rocks producing tin placers. The region between the Main and Western Ranges was filled in with glacial drift to form the Bolivian Plateau and the topography became essentially the same as it is today.

The principal tin deposits of Bolivia are pneumatolytic quartz-cassiterite veins in acid igneous rocks or the Paleozoic sediments which the igneous rocks have invaded. In some districts stannite veins of hydro-thermal origin occur. Placer tin deposits are worked on a small scale, and pegmatitic deposits exist but have not as yet been exploited.

The tin veins vary in width from mere stringers to lodes up to 75 feet in width, and average from 1 to 3 feet. While the narrow veins may extend but a few hundred feet, the wide ones are sometimes traceable for thousands of feet on the surface and in some instances have been proved to depths of over 1,500 feet.

Cassiterite oxide of tin, is the chief ore mineral. Its symbol is SnO_2, and when pure it contains 78.6% metallic tin. It is a hard, (hardness 6 to7), and heavy, (specific gravity 6.8 to 7.1) white to black mineral with non-metallic luster, occurring either in brilliant adamantine crystals, granular, in dull botryoidal or kidney-shaped masses often with a concentric or fibrous radiated structure, or in rounded pebbles known as stream tin. In the lodes the cassiterite is sometimes associated with pyrite, pyrrhotite, arsenopyrite, chalcopyrite, argentiferous tetrahedrite, and small quantities of the sulphides of tin, lead, zinc, antimony, molybdenum, and bismuth. Wolframite is a frequent associate of cassiterite in some localities, and silver minerals are in others. Often the cassiterite occurs practically pure in the veins in separate streaks of granular or crystalline mineral. At times it forms concentrated residual deposits in the bottoms of caves in the veins from which its associates have been leached. At other times the vein filling is brecciated and the angular fragments of the country rock are cemented and impregnated with cassiterite and its associate minerals. The chief gangue minerals are quartz and the minerals of the country rock. They are frequently associated with tourmaline or siderite, and more rarely with fluorite or scheelite.

A number of rare tin minerals occur in Bolivia. These are Canfieldite, $4Ag_2S\ (SnGe)\ S_2$, which is found at Aullagas; Cylindrite, $Pb_2FeSn_4Sb_2S_{14}$, which is found at Poopo in Oruro and Chocaya in Potosí; Franckeite, $Pb_2FeSn_2SbS_{14}$, which is found at Poopó; Stannite, $(C_4\ FeSn)\ S$, which is found at several localities; Teallite, $PbSnS_2$; and Native Tin, Sn, which is found at several mines. Of these rare mineral, stannite is the only one which ever occurs in sufficient quantity to constitute an ore. It is a steel gray to black mineral with metallic luster, a hardness of 4 and a specific gravity of 4.5. It is commonly massive and granular, but in rare cases it occurs in black crystals resembling in shape those of chalcopyrite.

The average grade of Bolivian tin ores is difficult to determine as very few companies keep estimates of the quantity of ore mined or of the quantity of tin lost in tails and waste. The interest centers to such an extent in the amount of picked ore and concentrates produced that in most cases little attention is paid to the actual grade of ore mined or to the losses sustained in hand sorting and milling and the majority of the companies have but the roughest idea of the average grade of their ores. In exceptional cases veins containing from 10% to 15% of tin are mined, but in the vast majority of cases the run-of-mine ore contains from 3% to 10% only, and it is probable that the average grade of ore mined does not exceed 5% of metallic tin.

IV. Mining laws.

The mining laws of Bolivia are good laws and compare very favorably with those of other countries. They have, however, been so loosely enforced as to present openings for numerous law-suits and in this way have done great harm to the mineral industry of the country At the present time, conditions are improving rapidly. President Montes is attempting to secure the strict enforcement of the law of forfeiture of mining claims for non-payment of taxes, and the National Corps of Mining Engineers under the direction of M. Maurice Mollard is mapping the mining claims of the country. As a result of these activities, the opportunities for law-suits are being rapidly decreased.

The more important provisions of the law affecting tin mining are as follows. The law considers soil and sub-soil to be two distinct entities,- the soil being the outward layer of the ground to the depth reached in agricultural work and in laying foundations, and the sub-soil all that lies beneath the soil. The sub-soil together with its mineral content is under the control of the State which has the power to abandon, grant, or convey its rights as provided. Mines are therefore estates different and apart from surface property even when mine and surface are both the property of one owner.

Prospecting is open to natives and foreigners alike. It may be conducted on lands belonging to the public domain and on private lands not protected by a fence without previous permission of the authorities.

The pertenencia is the unit of measurement for mining claims. It is a solid, measuring 100 meters square horizontally on the surface, and with perpendicular sides extending to an indefinite depth. The area of the pertenencia is thus 1 hectare, equivalent to about 2.47 acres, and it takes a little over 8 pertenencias to equal 1 American mining claim. Any number of pertenencias may be taken up by an individual or company in a known mining district, but in a new tin district only 30 pertenencias may be located. The claims may be taken in any direction but must be so grouped that the adjoining pertenencias shall have a common side.

The first step in securing a mining claim is to file a petiton with the prefect of the department in which the property is located. The prefect then issues a concession which is made public by 3 advertisements appearing at intervals of 10 days. The prefect also notifies the owners of adjoining properties. Opposition must be made within 70 days of the publication of the first advertisement. Within this same period, if no opposition develops; or in case of opposition, within 60 days of a finding in favor of the applicant, the property must be surveyed. Upon the completion of the survey, the prefect gives possession to the applicant.

The concession is made in perpetuity subject to the payment of a tax. The tax on tin lode properties is at the rate of B/4, $1.60), per year, and upon tin placers it is half this amount. Abandoned dumps, slag heaps and tailings piles may be located and worked without the payment of a tax. The tax on a lode or placer begins with the date of the concession and is payable semi-annually in advance. If it is not paid during the first month of the semester interest is charged at the rate of 9% beginning with the second month. When taxes and interest remain unpaid for 2 semesters, the prefect notifies the delinquent to pay up inside of 15 days or forfeit the property.

The following export taxes on tin are in effect at the present time.

TABLE II EXPORT DUTIES ON TIN BARS AND CONCENTRATES.

PRICE OF STRAITS TIN IN LONDON	EXPORT DUTY PER 100 KILOGRAMS	
	On Concentrates	On Bars
Less than £100	B/2 [$0.80]	B/ 3.25 [$1.30]
£ 100 to 110	Bs. 2.20	Bs. 3.50
110 ,, 120	,, 2.85	,, 4.37
120 ,, 130	,, 3.50	,, 5.24
130 ,, 140	,, 4.15	,, 6.11
140 ,, 150	,, 4.80	,, 6.98
150 ,, 160	,, 5.45	,, 7.85
160 ,, 170	,, 6.10	,, 8.74
170 ,, 180	,, 6.75	,, 9.61
180 ,, 170	,, 7.40	,, 10.48
190 ,, 200	,, 8.05	,, 11.35
200 ,, 210	,, 8.70	,, 12.22
210 ,, 220	,, 9.35	,, 13.09
220 ,, 230	,, 10.—	,, 13.96
230 ,, 240	,, 10.65	,, 14.85
240 ,, 250	,, 11.30	,, 15.70
250 ,, 260	,, 11.95	,, 16.57
260 ,, 270	,, 12.60	,, 17.44
270 ,, 280	,, 13.25	,, 18.31
280 ,, 290	,, 13.90	,, 19.18
290 ,, 300	,, 14.55	,, 20.05
300 and over	,, 15.20	,, 20.92

V. Labor and Power.

The population of Bolivia is sparse, and only 10% white, the remainder consisting of Indians and of half-breeds, known locally as "cholos." Most of the work in the mines is perfomed by Indians of the Aymará and Quichua nations, (See Figs. 5 and 6) while the responsible positions are usually held by foreigners.

Aymara Indians on Market Day.

Indian labor of all ages and of both sexes is employed in the mines and mills of Bolivia. The wages paid to miners vary from B/s1 to Bs4 and average about B/2.50 per day. ($0.40 to $1.60, averaging about $1.00). Better results are usually secured when the Indians work on contract under strict supervision. A pernicious leasing system is wide-spread, by which the contractor or "pirquinero" is permitted to mine as he chooses providing he sells all of his picked ore and concentrates to the mine owner at a fixed rate. Under this system, the mine's eyes are soon picked out, and heavy expenditures are necessary to put the mine in shape for proper working once more.

Quichua Indians of Bolivia.

The Indians make fairly good miners and under ordinary conditions are honest and dependable, but they are addicted to the use of cocaine and of alcohol and to the celebration of feast days. Coca leaves are chewed daily, at regular intervals or continuously, and render the Indians stupid. The feast days are numerous and when they arrive, every Indian gets drunk on alcohol and stays drunk for days. Figure 7 shows Aymará Indians celebrating feast day.

There is difficulty in obtaining sufficient labor in some localities, especially when the construction of railroads in the neighborhood attracts the Indians from the mines. Contracting for labor is much in vogue, the contractor receiving B/1 for each Indian supplied. Sometimes the contractor is also paid B/0.50 for each of his Indians who stays a second month, and B/0.25 for each who stays a third month.

In spite of the scarcity of labor and the bad habits of the Indians. it is well-nigh impossible to find other labor to take their place. For the Indian is acclimated and can perform labor that is impossible to the vast majority of foreigners. However, as air-drills and other labor saving machines are introduced, it should be possible to replace the Indian in large degree by foreign miners.

Power is another serious question with the Bolivian miner. Steam is expensive and is therefore only used on a small scale and then mainly for auxiliary power. Coal, charcoal. Llama dung, ("taquia") and a resinous plant known as "yareta" are the principal fuels. Coal cannot be used extensively owing to its high cost, due entirely to the freight from the coast which at times amounts to three times the cost of the coal at the seaport. Antracite gas-producer engines have proved economical and oil engines have found a wide application, the oils used coming from the Lobitas field in Peru. In calculating power plants for Bolivia, it must be borne in mind that the efficiency of any power requiring oxygen for its generation is reduced at least 3% for every rise of 1,000 feet above sea-level, so that a deduction of some 40% must be made for mines on the Bolivian Plateau and of more than that for mines in the high Andes.

A few of the Bolivian mines are blessed with water power or hydro-electric power. Many good water power sites exist within effective electrical transmission dis-

tance of tin mines, and these will undoubtedly be developed in the future and go far toward solving the power question.

Aymara Indiana Dancers Celebrating a Feast Day.

VI. Mining.

Bolivian mining methods are, on the whole, extremely crude. Prospecting and developing are almost unknown arts. Few indeed are the mines which can boast of any preparatory work whatever The native miner, whether he be the owner of the mine or a pirquinero, always has in mind the production of small quantities of rich ore from shallow workings. Thus while the mines under the superintendence of foreigners are opened by working tunnels, those operated by natives are commonly opened by "piques," which are little inclined shafts run in the vein. The piques follow the ore through all its twists and turns, and wherever rich ore is encountered it is taken out and sent to the surface on the backs of men and boys.

Mechanical drills have recently been introduced into Bolivia and their use is rapidly spreading. The Llallagua mine employs 60 Ingersoll stoping drills and is driving with piston drills and Temple-Ingersoll electric-air drills. Señor S. I. Patiño is using Siemens-Schuckertwerke electric drills and Temple-Ingersoll drills. Messrs. Harrison and Buttiger are using 4 Siemens-Schuckertwerke electric drills at Araca. The Avicaya mine is using Stephens "Climax" drills for driving. The Compañia Minera de Oruro and M. Louis Soux of Potosí are using Ingersoll-Rand air-hammer drills for all purposes. Messrs. Aramayo, Francke & Company have been driving with Temple-Ingersoll drills and are now beginning to sink and to drive with air-hammer drills. The Totoral mine has ordered an electric plant and is going to install Temple-Ingersoll drills.

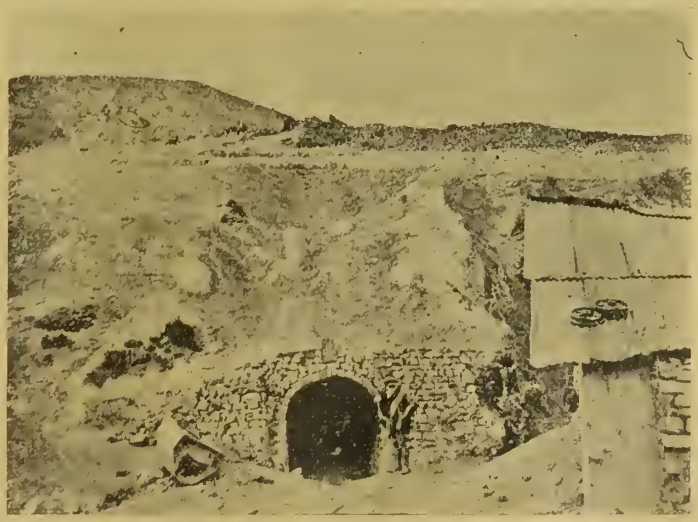
The explosive most commonly used in the Bolivian mines is 50% gelignite, although several mines employ 62% gelignite and 90% gelatine is required to do the work in the Totoral district.

The price of wooden timbers is so high that they are only used for special purposes such as the timbering of important shafts. Fortunately the ground is usually hard and stands well without timber. Where this is not the case, dry walling is resorted to with satisfactory results, arches of waste being constructed along tunnels with bad roofs (as shown in Figure 8,) and pillars of waste being erected in bad stopes. The stopes are made as narrow as possible, and stope filling is not practised.

Almost all mine haulage is performed by men or by mules, but electric haulage is employed in the Huanchaca mine and an electric engine has been installed in the Avicaya tunnel.

The ordinary Bolivian miner's lamp consists of an open iron vessel fitted with a wick to burn tallow. Candles are also in wide use. In this connection, it is amusing to note that when the operators in the Oruro district furnished the miners with candles the consumption was very great, but since the miners have been required to supply their own, rather than pay for them, the miners have contracted the habit of pounding their drills in the dark! Acetylene is being tried at Potosí, while at the Huanchaca, San José, and Compañía Minera de Oruro mines the passages are lighted by electricity.

Natural air currents, assisted in some cases by the escaping air from machine drills, are depended upon for ventilation in almost every instance. The Oploca mine, however, employs a small rotary blower to assist the natural ventilation.



Dry Walling in Tunnel of Carmen Tin Mine.

The greater number of the Bolivian mines are exploited by means of tunnels which serve to dewater them. Among the exceptions are the Huanchaca mine which removes immense quantities of hot water by means of electrically operated pumps, the San José and Compañía Minera de Oruro mines which both have large steam pumps, and the Morococalla mine which is equipped with a newly installed Cornish pump.

VII. Milling.

Hand picking suffices to prepare a small part of the Bolivian tin ore for market, a little stream tin is shipped in the same condition that it is taken from the beds of the streams, and a small amount of ore is smelted at irregular intervals, but by far the greater part of the Bolivian tin ore is milled and exported in the form of concentrates containing from 55% to 70% of metallic tin and known locally as "barrilla."

The milling of ores from the oxidized zone which contain little or no sulphides is a comparatively simple process, while those from the sulphide zone require a rather complex treatment. When concentration alone will not effect a good separation on account of the presence of sulphides, the ores are roasted to free the tin mineral. They are subjected to a preliminary concentration to remove as much of the waste gangue as possible, are roasted, re-ground and again concentrated, either upon wet concentrating machines as in the first instance, or upon magnetic separators. Tin ores containing silver are given a chloridizing roast and leached to remove the silver content before being concentrated to collect the tin.

Primitive methods of ore concentration are in use at most of the small mines. Crushing is usually performed with rocking stones known as "quimbaletes" which are operated by hand. In a few instances, a Chilean mill with stone wheel operated by waterpower, like that shown in Figure 9, is employed. The crushed ore is screened by hand and concentrated by hand in jigs, circular buddles and moss-bottomed launders. The various operations are repeated according to complicated systems until barrilla of the desired tin content is produced. The loss by this method is said to be about 30% of the tin in the ore, but in many instances it is undoubtedly greater.

Llamas bringing Tin ore to Dry Chilean Mill operated by Waterpower.

The foreign companies and some of the best native ones have erected modern mills containing machinery imported from the United States or Europe. The loss in these mills may be brought below 10%, but it is frequently higher on account of the high grade of the material treated, the improper selection of machinery, and above all the difficulty of securing skilled labor. It is a common thing to see the native millmen sweeping down the Wilfley tables with brooms as if they were a sort of buddle, and in some mills the Wilfleys will be found discharging all their products over the end,—perhaps wth a board nailed to the lower side to prevent any material from escaping by its proper channel. In such cases, the tailings can be re-treated at a profit by primitive methods, and it is customary to find Indians working over the tailings as shown in Figure 10. In order that Bolivian tin

Tailings from a Modern Tin Mill in Bolivia being worked by primitive methods.

milling shall be properly performed, it is almost essential that foreign millmen be imported.

VIII. Costs and Profits.

The cost of mining and milling 100 tons per day may be placed at about $7 per ton. Assuming that the ore contained 5% tin and was concentrated 14 into 1 with a loss of 10% to make 63% barrilla, then the cost per ton of barrilla would be approximately $100. It would cost in the neighborhood of $100 more to transport this ton of barrilla to the smelter in England or Germany, paying all taxes, commissions and incidentals. Smelting and refining might come to $75 more; making the total costs per ton of barrilla amount to $275. With Straits tin quoted at £160 in London,—or say $800,—the tin in the 63% barrilla would be worth about $500 and the shipment would net $225 per ton, equivalent to $16 per ton of original ore. The large shippers are able to reduce their costs to considerably below the figures named.

The actual process of marketing is much more complicated than the preceding paragraph indicates. Thus the barrilla is quite commonly weighed in Spanish quitales of 46 kilograms at the mine in metric quintals of 100 kilograms at the railroad, and in English tons in England. Then the charges are paid in the moneys of three different countries,—Bolivia, Chile or Peru, and England or Germany,—and the rates of exchange are so variable as to seriously affect all calculations of profit and loss. Finally, the smelting and refining charges are based upon an agreement between seller and buyer which includes a sliding scale to allow for variations in the tin content and purity of the barrilla.

Nevertheless, the Bolivian tin business is a profitable one, and it is to be hoped one result of the European War will be to divert some of this business to North America.

Mining in Peru *

La Sociedad Exploradora de Caylloma Consolidada (Caylloma silver mines) are now making a capital expenditure of about £40,000, with the object of increasing the capacity of the mill and concentration plant. At the present time a mill is being installed with 12 Nissen stamps to treat one hundred tons of ore per day, after which there will be a preliminary concentration followed by cyaniding. The cyanide treatment to be introduced will be sands and slimes—about 50 per cent of each. The entire mill will be run by electricity and the power increased, by the installation of a 160 h. p. plant, the present equipment being 360 h. p. The whole should be in running order by the middle of 1915, and will have a capacity for treating 36.000 tons of mineral per month, of an average of 30 oz. silver per ton. Of this ore there is in sight sufficient to keep the mill going for four years at this rate of production and represents considerably over three million ounces of silver, after allowing, for loss in treatment. At the present time the mines are exporting about 12,000 oz. of silver per month from picked ore running as high as 300 to 400 oz. per ton. Similar satisfactory progress can also be reported in the development and exploration work, for the driving of the big tunnel has just been completed to a length of 1,200 m., and two other tunnels which are to reach the respectable lengths of 3 and 2 kilometers respectively are also steadily going ahead.

Caylloma Silver Mines

The Caylloma mines are reached from the station of Sumbay on the Southern Railways of Peru, about 100 miles distant, and are situated at 16,000 ft. above sea-level, probably the highest mines being worked in Peru. The mill is situated at 14,600 ft. and most of the staff have their residential quarters there. The climate is good but manual labor is performed with difficulty by natives from the coast. The company is registered in Chile but its share list is distinctly cosmopolitan. The nominal capital is £100,000, subscribed in shares of five shillings which have had remarkable fluctuations and active dealings on the Valparaiso stock exchange, quoted sometimes as high as 50 pesos per share, but their price to-day is about 8 pesos (6s. 8d.).

The mines were worked by an English company from 1892 to 1906, but the persistent error committed of treating the ore by the Bolivian system of pan amalgamation was largely responsible for the failure of the company, and in addition the company was involved in litigation concerning titles. In 1906 capital was subscribed in Chile to take over this property and it has since been constantly worked with varying success until the present period when the fortunes of the company would seem to be assured by good management and encouraging exploration work. It is interesting to note that this company is managed by a technical staff of eight Englishmen and there are some 500 Peruvian workmen engaged in the mines, which number will be increased by 150 for the erection of the new machinery and subsequent running of the mill. Messrs. Graham, Rowe & Company, of Lima, are the commercial agents for the company.

Chinchipi Placers

One of the first serious attempts to "prove up" a gold placer proposition in the northern Provinces of Peru is about to be made by Messrs. S. E. Bayless, J. C. Nichols and F. J. Carnelli, joint holders of a concession to the placer rights on the river Chinchipi, a tributary of the Marañon, joining that stream some 50 or 60 miles below Bellavista, in the Department of Jaen. The concession covers the placer rights on the Chinchipi from its mouth to the Ecuadorean border, a distance of more than 100 miles, including all of the tributaries; the concessionaires agreeing, in return, to construct a trail which will branch off from the road north from Huancabamba, pass through San Ignacio and reach the banks of the Chinchipi. The trail must be at least two metres wide, the gradient must not exceed 10 per cent, it must be commenced in May of the present year and completed before May 1, 1915. The trail will run in a northeasterly direction and will be between 40 and 60 miles in length. The concessioires are also compelled to maintain the trail.

The Government is to take 5 per cent of the gross output, when mining operations are commenced. The capital for the preliminary work has already been raised. Laborers can be secured at Huancabamba for a sol a day. Food supplies can be obtained at a low price in the latter city and on the lower reaches of the Chinchipi there are comparatively large cattle ranches where steers can be purchased for £3 a head, the low price obtaining because of the total lack of any but a local market.

The distance from Piura to Huancabamba is about 135 miles. From 80 to 90 miles of this is good wagon road across the desert, wide rimmed tyres being used, but for the remaining distance the road is very bad. The Chinchipi region is semi-arid in character with very little timber. The river is not navigable in any sense of the word, except for a mile or two above its junction with the Marañon. The elevation at this latter point is about 1,300 ft. the Chinchipi having a fall of about 15 ft. to the mile. There are very few settlers in the region and practically no Indian tribes of any importance. Mr. Bayless and his party expect to remain in the interior until November of this year, the commencement of the rainy season. Operations will be confined mainly to road construction. Hydraulicking and sluicing on a small scale will also be undertaken if time allows. It is proposed ultimately to place small dredges on the river if the returns come up to expectations. It is also proposed to from a company in the States, composed of the three concessionaires and one or two others, to work the deposits.

Santo Domingo Mine

Recent advices from the Carabaya district state that the new installation of machinery at the Santo Domingo mine of the Inca Mining Company has been completed, and that the mine is now able to handle 150 tons of ore every 24 hours. The new installation consists of 10 stamps, two Huntington mills, two tube mills, one Dorr classifier, one Frenier sand pump, seven Frue vanners, four Dorr thickeners, three agitation tanks, three cyanide tanks and one Oliver filter press. The machinery is operated by a hydro-electric plant, developing 400 h. p., power being obtained from the adjacent river where plenty of water is always available. The installation was commenced 18 months ago.

Previous to that mine the equipment consisted of a small five stamp, quite inadequate for the treatment of the large quantity of low grade ore taken from the mine. Nothing less than 20 dwt. was treated, but the

*From Peru To-day.

company is now in a position to treat ore with a gold contents as low as 8 dwt. with a good margin of profit. The tailings to be treated with this new machinery, it is estimated, will produce a value of £200,000 gold, the extraction of which will require some three years. There is an additional value of £200,000 gold, in ore, blocked out in the mine, at the present time. Work was commenced at the Santo Domingo mine in 1896 and in the first ten years £1,400,000 gold was taken out. The method employed in the treatment of the ore or tailings with the new installation is known as the all sliming cyanide process. The plant is a gravity mill, that is the ore or tailings from the time they enter the mill, will pass through the process without requiring elevation, the site being 150 ft. vertical from the car track to the sumps. The new works have been ready since November last and the date of starting will depend upon the arrival of the new Francis turbine from New York. Power is hydro-electric and the power plant is situated one league distant. E. G. Davidson is the resident engineer and Burt Collins is general manager.

Marañon River Placers

Work on the gold placer claims of The Peruvian Exploration Company, on the Marañón river, is forging ahead rapidly and there is now a working staff of nearly 300 men, with 15 Californians and Canadians, with expert knowledge of hydraulic operations, at the Company's camp. Some 1,500 "cargoes" of machinery (250 lbs.—1 cargo) have been delivered on the ground and 3,000 more have reached Cerro de Pasco. It has been decided to install a central station electric plant with an ultimate capacity of 2,000 h. p., which for the time being will be limited to 600 h. p. Washing operations, it is hoped, will commence in the fall of the present year with 10,000 cu. yd. per day of 24 hours. The point chosen for this installation is Uchapampa, and operating from this central station there will be at least five different points of working with hydraulic elevators capable of a daily total production of 50,000 cu. yd. The costs will not exceed six cents per cubic yard and as the gravel goes 81 cents, there is an estimated profit of 75 cents gold per cubic yard. Work has just been commenced on the power-line ditch, and Raymond McCune, promoter and chief engineer of the company, has recently returned to New York to place orders for further equipment.

La Cotabambas Auraria

The shareholders of La Cotabambas Auraria, operating in the Department of Apurímac, held an extraordinary general meetings in Lima on Mar. 28 last, when more than three-fourths of the capital was represented. Amadea de Piérola, the managing director, read his report and balance sheet which denoted the prosperous condition of the company, enabling the board to acquire a considerable amount of new machinery which has been installed and is at work including electric drills, the first of their kind introduced into Peru. This machinery will facilitate the more rapid working of the mine, and with the mineral in sight of good gold contents, the company has a regular minimum monthly production guaranteed to the end of the present year at least, equivalent to the value of £3,000, the average for the last three months having been £3,854 per month.

The meeting unanimously approved the programme of the directorate to immediately develop the property on a large scale, and to this end increase the capital of the company to £150,000. Of this sum it was agreed to subscribe at once £30,000, giving the present shareholders the preference to subscribe this amount amongst themselves. Those present at the meeting forthwith subscribed £20,000, and the absent shareholders were given an option of 15 days to subscribe the remaining £10,000.

Cerro de Pasco

One of the most interesting proposals under consideration at Cerro de Pasco is that an American syndicate, now investigation the possibilities of working the ore dumps by a cyanide process. The low grade silver ore tailings scattered over the pampas at Cerro de Pasco, amount to more than 15,000,000 tons, running 15 oz. of silver to the ton, and it is stated that with the erection of a cyanide plant this ore could be treated at a profit of from 4 to 5 soles a ton. This would mean a total profit of from £6,000,000 to £7,500,000 and would make Cerro de Pasco a silver producer of considerable magnitude as well as a copper producer. The proposals looking toward the erection of cyanide plant have not been finally passed upon.

The construction of the new 12,000 h. p. hydro-electric plant at Oroya, practically doing away with the old boiler house plant, was completed in the latter part of 1913, the installation having been under the direction of A. L. Wilcox. There is a 10½ mile ditch and pipe line, delivering 200 sec. ft. of water to six Pelton wheels, connected in sets of two with three 3,000 kw. dynamos. The cost of this installation is said to have been in excess of £200,000. A 70 mile transmission line serves both Cerro de Pasco and the company's holdings at Morococha. The smelter plant at La Fundición now consists of five blast furnaces, two Pierce-Smith 10 by 25 by 10 ft. basic-lined converters, two 11 ft. spherical converters, two 7 ft. Parrot type converters, five 19 by 60 ft. coal-fired reverberatory furnaces, fourteen 18 ft. sixhearth McDougall roasters and ten Dwight-Lloyd sintering machines. The coal saving effected by the installation of the hydro-electric plant and the active development of the Quishuarcancha coal mine is expected to eliminate the coal shortage which has curtailed the company's operations in the past. The Morococha Mining Company, a sibsidiary of the Cerro de Pasco, although in a preliminary stage of development is producing in the neighbourhood of 80,000 to 90,000 tons of ore a year, which is shipped to La Fundición for smelting.

Morococha

The new 2,000 h. p. hydro-electric plant of the Backus & Johnston (Morococha) Company, six kilometers below Casapalca, was completed in November and is now supplying power to the smelter at Casapalca. A transmission line 18 kilometres in length is being extended to the company's property at Morococha and should be completed early in June. During the past few years extensive improvements and additions, inaugurated by the late J. Howard Johnston, have been effected.

The various mines at Morococha have been equipped with electric pumping and hoisting machinery, and an Ingersoll-Rand air compressor and machine drills installed. Similar installations have been made at the Casapalca mines of the company and electric traction has been introduced to replace mule haulage. In the concentrating department a second Krupp wet ball mill, a Hardinge conical ball mill and a McCully crusher have been placed, and in the smelting department, a Dwight &Lloyd sintering machine, a second blast furnace, two converter stands, one Norberg air compressor, and one electric and one hydraulic elevator. The present smelting capacity is 12,000 tons per month. The hydro-electric plant consists of two units and it is proposed to add a third unit shortly, increasing the h. p. from 2,000 to 3,000. The length of the ditch line is 1,300 meters. The water available is in excess

of 3,500 litres per second, and is conducted directly to Voith turbines, coupled with 2,000 volt dynamos. The Casapalca smelter is a silver-copper plant and during 1913 produced 1,950,000 oz. of silver.

Huillca Copper Mines

The Morococha region is one of the most actively worked mining zones in Peru at the present time, and apart from the extensive holdings of the Cerro de Pasco and the Backus & Johnston copper companies, special reference may be made to the property belonging to La Compañía Huillca y Restauradora Unidas, owned by Víctor Vannoni and two partners. The average contents of the ore extracted from these mines is 10 per cent copper and 40 oz. silver and leaves a net profit, at present prices of metal, of £5 per ton at the mouth of the mine. Active work is now going on in the driving of a tunnel, a kilometre and a half long, which is intended to cut the numerous veins on all the properties owned by this company. When the work is finished in less than two years, the monthly production will be, it is estimated, not less than 1,500 tons, which if values are maintained will represent a net profit of £90,000 per annum. At the present time the whole of the Huillca output is being taken by the Backus & Johnston smelter, as it a most excellent smelting ore with good fluxing properties.

Huaron Copper Mines

La Compagnie des Mines de Huaron have had for some time past a corps of engineers engaged on a thorough examination of their properties in Huaron, some 35 miles from Cerro de Pasco, and the results of their investigations have been so satisfactory that exploration work on a much larger scale, involving the inversion of several million francs, has now been authorised by the board. It is the intention to at once install a 260 h. p. hydro-electric plant which will be ready for working at the beginning of next year. The present plant is steam of about 150 h. p. The main sinking pump will be supplied by the International Steam Pump Co., and will be driven by a General Electric Co. motor. The rock drills are being supplied by the Ingersoll-Rand Company. At a later date when the reserves of ore opened up, fully justify it, a smelter will also be erected, and from all present indications the output from these mines will then rank with the biggest copper producers of this region, the ore also being of a high grade. Mons. Gascuel is the managing director of the company, resident in Paris, and has recently made his usual annual inspection to the property, Mons. Aubry being chief engineer and general manager at the mines.

Tungsten Ores

Practically the only tungsten properties so far discovered in the republic are now being developed in the Conchucos district of the Department of Ancash and La Libertad. Tungsten has also been located near Lircay, Province of Angaraes, Department of Huancavelica, but the character and extent of these deposits are little known. In the Conchucos district there are three properties, viz., the mines of the Conchucos Tungsten Company, the Pelagatos Mining Company, operating the Pelagatos and El Plomo mines, situated on Huallapon mountain, and the properties controlled by C. Weiss & Co. of Lima. Operations on the Conchucos property are at a standstill. A plant was partially installed by the backers of the venture but before this was completed funds were exhausted and the work stopped. An effort is now being made to secure the aditional funds to continue the operation of the property.

The Pelagatos mines are being operated under the management of Andrés Castro and about 100 metric tons of tungsten concentrates is produced annually, with the plant working one third time. The capacity of the present mill is from 13 to 14 tons, while it is planned to shortly install a 40 ton mill. The operation of the smaller mill will also be continued. Harth & Co., of Lima and Paris, have been acting as agents.

The methods employed in the separation of the complex tungsten ores at this mine, in view of the primitive machinery used, is deserving of high praise. The Pelagatos ores run about 25 per cent. copper, 25 oz. of silver and 3 per cent. WO_3, the tungsten tri-oxide. The principal vein from which the ore is extracted is about 32 in. in width and runs across the Huallapon mountain, on the side of which the mine lies, at an altitude of about 15,000 ft. above sea level. The workings are 600 ft. below the crest. Huallapon mountain is one of the peaks of El Plomo range.

The third property controlled by Wiess & Co., generally known as the Huaura mine, situated on Huaura mountain, at about the same altitude as the Huallapon, is still operated by primitive methods, and its production is practically the same as that of the Pelagatos mines, that is 100 metric tons of concentrates annually. A. Haggenmiller has recently taken over the technical direction of the work here and under his supervision a mill will shortly be installed, with a capacity of about 20 tons.

The underlying rock formation throughout the district is granite of different classes with superimposed layers of quartzite and slates, in which layers the most valuable ores are found. The orebodies so far discovered in the granite formation lack permanency. The deposits of the greatest richness are found on the dividing line between the slate and granite and the granite and quartzite. So far, the work done is insufficient to make it possible to draw any definite conclusion as to the richness of the district, although there is every indication that it will become an important producer of tungsten ores. The latest figures available for tungsten production in Peru are those of 1912, which the Boletin of the Cuerpos de Ingenieros de Minas gives as 195 metric tons of hubernite and wolframite ores, the concentrates containing between 64 and 68 per cent of WO_3, giving 131 metric tons of tungsten.

By far the greatest source of danger in tunnel work at present is from falls of rock. These can be prevented in a large measure by promptly and adequately supporting the roof. Insist that necessary timbering be done at once and always keep a supply of lumber at hand for this purpose, so that no delay may ensue for lack of it. True, timbering is laborious and it either takes the men of the tunnel crew from their regular work or requires extra men. Although you may suspect that the roof is dangerous, you may be tempted to delay timbering—possibly until an accident brings the necessity forcibly and unavoidably to the front. Remember that all necessary timbering can not be done too soon, and that any delay seriously jeopardizes the lives and limbs of the men who have to work under a roof improperly supported.

Approximately 90 deposits of tungsten ores are known in Bolivia at present, the most important of which are situated in the departments of La Paz and Potosi, Exports were estimated at $89,932 in 1911 and $114,847 in 1912. The crushed ore is concentrated on tables. Wolfram concentrates containing tin are calcined and treated by magnetic separation. Sometimes silver occurs in the tungsten or tin ores.

Travel and Mining in Honduras.

By Rensselaer H. Toll. *

*Honduras has an area of but 50,000 square miles, less than half size of the State of Colorado. Its population is estimated at 400,000; comprising 185,000 Indians, 205,000 of mixed blood, 5000 negroes, and 5000 whites, most of whom are of Spanish descent, thouht a great many Americans and Europeans are scattered along the coast, in the larger cities of the interior, and through the mining regions. The coast-lines of Honduras run nearly east and west. The Caribbean coast is about 400 miles long and has many good harbors, such as Trujillo, Ceiba, Tela, Omoa, and Cortez, the last-named being the usual port of entry for travelers. The Pacific coast is occupied by San Salvador, leaving but sixty miles to Honduras, which, however, contains the beautiful harbor of Amapala. Both coasts are unhealthy, but the miasmic influence does not extend far inland.

As elsewhere in America, the principal rivers flow to the Atlantic. The Segovia, or Coco river, which is the boundary between Honduras and Nicaragua, is about 350 miles in length; but it flows rapidly over a shallow rocky bed and is navigable only by canoes. The largest river entirely within the boundaries of the country is the Ulua, which flows north and is formed by the confluence of the Santiago and the Comayagua, with their tributaries, the Santa Barbara and the Sulaco. Steamers of shallow draft can ascend the Ulua as far as the mouth of the Santiago, about 70 miles by the stream. The Comayagua river rises in the mountains at the southern border of the great plain of Comayagua, more than two-thirds of the distance to the Pacific coast; and the streams of the Ulua system drain about one-third of the entire territory of Honduras.

As a whole, the country is very mountainous, not even the coasts being free from rugged heights, for along the Caribbean many mountains raise their proud heads above the clouds while their feet are bathed by the ocean surf. Nor are their elevations insignificant, for many peaks reach an altitude of 9000 ft., while in the Sulaque mountains are some which approximate 10,000 ft., above the sea. Mountainous as the country is, there are no consecutive ranges of great length, the longest being the Sierra Madre, and this splits into two parts soon after leaving Guatemala. Between the various small ranges of mountains are broad fertile plains like that of Comayagua, which is about 40 miles long from north to south and 10 miles in average width; the plains of Yoro and Olancho, celebrated for the excellence of their cattle; the plains of Omoa, Sensenti, and many others, all extremely picturesque and fertile.

Mineral Resources.

Honduras ranks high in mineral resources; among the metals so far discovered being gold, silver, copper, iron, lead, zinc, antimony, and nickel. Kaolin, opal, aluminum, chalk, coal, asphalt, and petroleum also are found in quantities which will doubtless render them all profitable under more advantageous conditions. All kinds of building stones, including marble of a fine quality suitable for statuary, are found. Because of the inadequate transportation facilities and civil strife, only the precious metals can be mined profitably at present. Many of the rivers, especially those flowing into the Atlantic, contain gold in quantities large enough for the Indians to work, and there are several small quartz-mines in operation. Some of the placer gold is said to contain platinum in so appreciable an amount as to be paid for by the United States mints. But despite this showing, the only mine of present importance in Honduras is the San Juancita, owned by the New York & Honduras Rosario Mining Co., with headquarters in New York. This mine is in the department of Tegucigalpa, about 20 miles north of the capital, on the northern slope of a steep and high mountain formed principally of andesite overlying black shale.

The main veins, the Rosaria and Candelaria, strike generally east and west, dipping steeply to the north, in places being quite vertical. These veins have been worked for over thirty years, and there are about 30 miles of workings, with a vertical extent of 1800 ft.; but the mine is said to be in better condition now than ever before. Within recent years important north and south veins have been developend, which appear to have given the property a new lease of life. The mine is equipped with electric haulage, and a single-rope tramway conveys the ore to the mill, an old affair of fifty stamps and two tube-mills. The metals are extracted in the cyanide plant, which has mechanical agitation-vats and Butters filters. The precipitate is shipped to New Jersey, as the cost is about the same as for that of reduction at the mill.

About 3000 tons per month is milled, and the annual production is close to 1,000,000 oz. of silver and 16,000 to 17,000 oz. gold. About 2000 men are employed, of whom 40 are Americans. The equipment of the Rosario is constantly undergoing renewal and improvement, two very fine hydro-electric plants having been built recently; and a new mill and cyanide-plant, offices, hotel, and club-house are in course of construction on the mountain-side at the level of the lower adit, 1500 ft. above the present townsite. The property is connected with Tegucigalpa by a most outrageous cart-road, which in the higher mountains is very muddy because of the numerous springs; and the grade in many places is over 30%. As an illustration of the difficulties of operation in such a locality, it may be mentioned that the cost for transportation of heavy freight from San Lorenzo, the port near Amapala, to San Juancita is 5c. gold per pound, light freight costing about half as much.

Mining Laws.

The mining laws of Honduras are very liberal. Any amount of ground may be denounced, but the usual size of claim is 500 hectares, or 1220 acres. By following a procedure similar to our patent proceedings, a title may be secured which is equivalent to a patent in the United States. The annual tax is 50cv. (about 20c. gold) per hectare, and so long as the taxes are paid the title remains absolute. But should they be unpaid for a period of two years, the ground reverts to the public domain and is open to denouncement again. As in Mexico, there are no extralateral rights, all boundary lines being vertical. For a small consideration one may obtain a concession to prospect and locate claims over a large area, during the term of which no one else is permitted to make denouncements within the specified territory. Upon application to the President, mining machinery and supplies may be brought into the country free of duty.

* Address delivered before the Colorado Scientific Society, April 1, 1911.

Ports and Railways.

The interior of Honduras may be reached through Puerto Cortez on the north coast, and Amapala on the south coast. From New Orleans the United Fruit Co. operates small steamers which make the trip to Cortez in a little more than five days, stopping at Belize, British Honduras, and Barrios, Guatemala. The steamship fare is $27 one way. From San Francisco to Amapala requires 22 days and costs four times as much; hence, though the trip from Amapala requires but three days over a good road, and that from the railroad at Pimienta to the Capital requires six days over a bad trail, much time and money are saved by going through Cortez. If the traveler has time and inclination he may take one of the large new steamers of the United Fruit Co. and catch one of the smaller ones at Barrios. These larger vessels are of 5000 tons burden and very comfortable—almost luxurious—and a trip on one of them is quite a delight. During the wait at Barrios he may run up to Guatemala City, the metropolis of Central America. and spend a day or two viewing this interesting old city and laying in a supply of silver jewelry and silk shawls for souvenirs.

Cortez harbor is one of the best on the Gulf. It is elliptical in shape, about nine miles in circumference, and deep enough for the largest vessels to anchor. Puerto Cortez is a straggling, crudely-built town stretching along the shore for two miles. Its single street is occupied principally by the Honduras railroad, whose terminus is the wharf at the lower end of town. At the upper end this road enters the jungle, bound for La Pimienta, on the Ulua river, 56 miles away, a distance usually covered by the train in about eight hours. This little narrow-gauge road is the first section of a transcontinental line which was projected to San Lorenzo, through the valleys of the Comayagua and the Goascoran, which practically bisect Honduras, a total distance of 232 miles. From 1867 to 1870 bonds to the value of about $30,000,000 were floated in London and Paris for the purpose of building this railroad. An English company took the construction contract on a percentage basis, and it was profitable, therefore, to make the construction as costly as possible. So, between the commission for the sale of the bonds and the padded accounts for material and labor, by the time the road had reached San Pedro the proceeds from $25,000,000 worth of bonds had been consumed; a cost of nearly $700,000 per mile. The road was finally completed to the Ulua river and graded several miles beyond, but the Government was bankrupt. Notwithstanding the enormous cost, the construction of this railroad was wretched. For miles the rails were laid upon the bare ground, without ties of any kind, being held in place by stakes driven in the earth. They soon became imbedded to such a depth that lateral movement was impossible, so the trains probably kept the track as well as they do now. But, bad as the track and cars are, this little railroad presents many interesting features. For many miles it runs through a dense jungle of palms and other tropical foliage whose sweeping branches cast grateful shade over passing trams, while the trailing vines, covered with morning-glories and flowers of strange shape and gorgeous colors, lend fragance and magnificence to the scenery, which the most carefully cultivated lawns and flower-beds of our great Eastern roads cannot equal. A dozen miles from the coast the jungle frequently gives way to large cleared pastures, and fincas where the luscious banana hangs from the broad-leafed stalk; and at each station cars are being loaded with this nutritions fruit.

The day before our arrival at Cortez the American and English officials had taken charge of that port and had shipped the Honduran army out of Cortez and San Pedro and dumped it off at the end of the railroad. When we reached that point a most interesting sight met our eyes. On the opposite bank of the river was the camp of the Government forces, with a line of entrenchments stretching along the bank for a half mile. All the boats were moored on the farther side of the river; more than a thousand riflemen were in their pits and trenches, ready for battle; nine machine-guns and two 2-lb. cannon were loaded and trained upon the town and railroad, and the camp was in general readiness, if not eagerness, to cut down ruthlessly any revolutionists that might get off our train. Fortunately for us, we carried no such passengers.

Travel in the Interior.

At La Pimienta one is obliged to take passage on a mule, and here the really tiresome portion of the journey begins, for five or six days on a Honduras mule is not the most delightfull experience in the world, even to a stranger, to whom the wonderful foliage, picturesque dwellings, the brilliant flora, and myriads of gorgeously plumed birds present an ever-changing panorama of loveliness. Soon the diet of **tortillas, frijoles,** and rice, and steady grind of the saddle, and the stings of numberless insects by day and by night, spoil the effect of the landscape, and before the end of the second day the screams of the vari-colored macaws flying in pairs across the sky, the chatter of monkeys in the trees, the bright plumage of the big-billed toucan, and the golden-tailed **Oro pendulum,** singing in melodious contralto from above its wonderful swinging nest at the end of the highest branches, have become commonplace.

By the end of the second day the traveler finds his chief interest in the application of witch-hazel to his sore muscles and iodine to his insect-bites, for the bane of existence in Honduras is the ravenous nature and overwhelming numbers of the insects. The timber-tick is always present in full force, the nimble flea fills every habitation; and along the coast the mosquito and the tiny sand-fly add their due portion to the sum total of human misery. But for objectionableness no other insect can compare with the **garrapata,** minute representatives of the tick family, which wait in hordes at the end of every branch along the trail to drop upon the passer-by, scatter over his person, and bury their screw-like heads in the flesh. Against them man has no protection but tobacco-juice, though by keeping one's clothing saturated with this drug one may pass through the interior with a small degree of freedom from these pests. Another very interesting insect is the **nigua,** which is almost microscopic and hence difficult to detect. Its principal business is to bore into the flesh at the side of the nail, usually on the toes, and deposit its eggs, which hatch there and produce sores similar to boils; the only remedy is to cut out the larvae, often a quite painful operation.

Outfit and Medicines.

For the benefit of those contemplating a trip into the interior it may be well to state that the outfit for the journey is best obtained at San Pedro—mules, **mozos,** and all. With proper credentials it is often possible to rent animals at about one peso per day. **Mozos,** or native attendants, may be engaged at the same rate. Often, however, one must purchase animals, and a good mule costs about $200 pesos; horses, $25 to $100 pesos. A saddle-animal, a pack-animal, and a mozo are required for each person, unless the party consists of more than three, in which case the proportion of pack-animals and **mozos** may be decreased.

The essential articles of clothing are: light underwear, khaki suit, good waterproof hat with broad brim, high boots; and a good raincoat kept strapped to the saddle—preferably a black rubber coat, as "oil-skins" and cravenettes are but slight protection against a prolonged tropical down-pour. It is not advisable to carry any luggage which can be damaged by rubbing on the outlandish native packsaddles or crushed by tight binding-ropes. Use heavy canvas bags or wrap in a bundle and cover with oil-cloth. It is well to lay in a small supply of canned goods and bread; for, though there are places along the trail where travelers regularly spend the night, noonday finds one far from habitations and the fare at the lodging-places is not sumptuous.

Do not forget a small assortment of bandages, cotton, court-plaster, surgeon's plaster, vaseline, carbolic acid, and witch-hazel; quinine, to allay fever; iodine;, potassium permanganate, and potassium bisulphate for stings and bites of insects or reptiles. I always carry an ounce or two of aconite to ward off colds. Five or six drops of this every couple of hours when one feels a cold coming on will do no injury and is a sure preventive. For sleeping purposes a pair of heavy blankets and a hammock or folding cot make up the equipment. It is not a a bad idea to carry a 0 38-calibre revolver for protection against unkindly disposed natives, and as a means of killing game. Deer are plentiful through the country; peccaries, tapirs, coyotes, jaguars, and other animals are found in some part of the interior; the iguana, a species of lizard which attains a length of three to four feet, is quite common, and the natives esteem its flesh a delicacy; squirrels abound through the forests; and there are ducks, geese, and numerous gamebirds, of which one of the most common is the **chachalaka**, which resembles the wild turkey.

The Honduran native is not so good a prospector as the natives in many parts of Mexico. He does not use his eyes and head to so much advantage in his work as the average Mexican, and does not recognize the different formations so readily; hence the country has not been nearly so well prospected as Mexico, and there is probably more chance of reward for intelligent prospecting.

Compressed Air for Ore Flotation.

New methods of accomplishing ore flotation are being rapidly developed, and a wide variety of means used to accomplish the purpose. One of the most interesting as well as successful methods is that of using air as the agitating and froth-producing medium. Plants using this method have been installed by the General Engineering Co., of Salt Lake City, Utah, at the National mill, in Idaho, the Magma, Miami and Inspiration in Arizona. The ore is mixed with oil and water and fed into a separator which cousists of a rectangular cell haying an inclined false bottom covered with fabric. Compressed air admitted into compartments below the false bottom passes upward through the fabric and is divided into innumerable small bubbles which form a froth 12 to 18 inches deep in the cell. Mineral concentrate rises with this froth and overflows the sides of the cell, while gangue flows down the inclined bottom and is discharged. If desired, the first cell can be used as a rough concentrator, and the valuable product re-treated in another cell. The products from several roughers could be combined on one cleaner. Pine oil has been found to be a good floating medium, and is used in the oil mixture in varying proportions.—**Metallurgical and Chemical Engineering.**

Resuscitation After Mine Accidents.

In line with its campaign to reduce the number of deaths in the mines of the United States, the Federal Bureau of Mines some time ago appointed a committee of eminent physicians and surgeons to develop an effiicient method of resuscitation to be administered by miners or other persons to a fellow-workman overcome by electric shock or by gases in places which cannot be reached by a physician or surgeon in time to save life.

As a result of this committee's report just made, the Bureau of Mines, through Director Joseph A. Holmes, recommends the following procedure in rendering first aid to those in need of artificial respiration.

Recommendations apply not only to men who are overcome by electric shock or gases in mines, but also to persons suffering from the effects of illuminating gas poisoning or from electric shock anywhere. The recommendation are, therefore, of importance to many thousands of workmen:

In case of gas poisoning, remove victim at once from the gaseous atmosphere. Carry him quickly to fresh air and immediately give manual artificial respiration. Do not stop to loosen clothing. Every moment of delay is serious.

In case of electric shock, break electric current instantly. Free the patient from the current with a single quick motion, using any dry non-conductor, such as clothing, rope, or board, to move patient or wire. Beware of using any metal or moist material. Meantime have every effort made to shut off current.

Attend instantly to the victim's breathing. If the victim is not breathing, he should be given manual artificial respiration at once. If the patient is breathing slowly and regularly, do not give artificial respiration, but let nature restore breathing unaided.

In gas cases, give oxygen. If the patient has been a victim of gas, give him pure oxygen, with manual artificial respiration. The oxygen may be given through a breathing bag from a cylinder having a reducing valve, with connecting tubes and face mask, and with an inspiratory and an expiratory valve, of which the latter communicates directly with the atmosphere.

No mechanical artificial resuscitating device should be used unless one operated by hand that has no suction effect on the lungs.

Use the Schaefer or prone pressure method of artificial respiration. Begin at once. A moment's delay is serious. Continue the artificial respiration. If necessary, continue two hours or longer without interruption until natural breathing is restored. If natural breathing stops after being restored, use artificial respiration again.

Do not give the patient any liquid, until he is fully conscious. Give him fresh air, but keep his body warm.

Send for the nearest doctor as soon as accident is discovered.

The value of the gold and silver bullion and ores exported from Salvador in 1913 amounted to $1,479,805, an increase of $83,075 over the previous year. The several mining companies in the country are improving their machinery and looking forward to slightly larger returns; the Butters Salvador Mines Co. is by far the largest mine owner in Salvador and produces the largest percentage of the gold and silver exported. With the exception of a small amount of slimes, etc., valued at approximately $100,000 all the gold and silver exported went to the United States.

Gold exported from Colombia, in August and September amounted to $546,000, compared with $471,000 in that period of 1913.

Requirements for Research Work.

Tests of ores for metallurgical treatment and investigations of processes does not necessarily require special aptitude or high technical training, but it does demand a good equipment of common sense. The stock of a man's common sense seems to be a fixed quantity and no amount of trainning can increase it in any marked degree. The best training for research work is a familiarity with the process and the principles involved in its operation, and this familiarity is not so much a matter of years devoted to a line of routine work as of intelligent interest and observation. Some men may not acquire a complete working knowledge of a mill in twenty years, while others who come with a mind ready to note variations and discrepancies may know all of its weaknesses within a week.

The first step in carrying on an investigation is to make up your mind as to precisely what you are after. In most minds this is so vague in the beginning that it is usually best to put it down on paper. This will compel clear thinking on the subject and will tend to fix the chief aims in one's mind. Increase of extraction and reduction of costs may both be of the greatest importance, but each should be attacked separately. It may be the aim of a series of tests to increase the value of a certain concentrate product. If during the tests the question of losses is allowed to take too prominent a part, there is likely to be a confusion on both issues. Test one point at a time.

Laboratory Tests.

In the beginning a large number of quick, qualitative tests are of equal value with more detailed experiments and will save a lot of time. Rapid separations in a beaker or a pan bear the same relation to detailed tests as a pencil sketch does to a finished drawing. They will frequently give a better general idea of conditions than a carefully worked out experiment with all its checks and controls. Find out whether a thing is possible or not in the shortest time and at the least expense; the details can be filled out later. "Get the facts as quickly and cheaply as possible, but get the facts." One fact at a time is enough to occupy any mind.

There is a common opinion that laboratory tests are unreliable and even dangerous. There is probably a reason for this prejudice in the failure of common sense. No reactions take place in the laboratory which do not also take place in the mill; but in the laboratory the sense of proportion is often lost. In the mill one can not get away from the importance of tonnage and volume. A number of hydrometallurgical processes have failed because the difficulty of handling and washing bulky precipitates on a large scale had been lost sight of in small-scale tests. The reactions were correctly workad out; failure came in the application .

One human failing must be guarded against constantly; optimism as to results is not proof. In no other line of work is absolute honesty with oneself and with one's figures so necessary and so difficult. Opportunties for straying from the narrow path are always present and tempting. A failure to put down in actual figures the losses in each step, a hopeful view of the time consumed, neglect of traces which will be multiplied in final products, and underestimates of wear and tear of apparatus are some of the pitfalls for the unwary investigator. A reduction of estimated profits by a lump percentage per ton is usually a safe procedure, but actual proof is better.

Keep the Object in View.

In most investigations there is one point which in importance transcends all others. This central reaction or principle should be studied first from all possible angles. In testing an ore for cyaniding, the important thing to find out is whether the minerals present are soluble in solutions. Until this is known the question of fineness of grinding or consumption of reagents is of no consequence whatever. Mines have been known to ship a carload of ore at great expense to a distant mill for a "mill-run," when a simple laboratory test on a half kilo of material would have answered quite as well.

The quantity of material handled in any given test is a question which calls for the use of much common sense. The prejudice against small tests is perhaps justified, but not in the sense commonly supposed. Large-scale tests may neutralize defects of sampling; but, provided the sample is truly representative, a small test is usually quite as good and accurate as a large one. The character of the process under investigation must in this also be taken into account. A coarse-grained copper sulphide ore which is to be treated by concentration will require a much larger sample than a cyanide ore for all-sliming. The ratio of size between the quarter-inch grains of pyrites and the original lumps of ore is much smaller than that between the minus 200-mesh slime and the mine product. In all-sliming tests one kilo tests are commonly quite as good as those involving 25 kilos, and they are much less expensive of time and material.

In testing, care in sampling is quite as important as in assaying. If the sample treated is not representative the results of the test will be worse than useless, for they will represent facts which do not fit the case.

It is in the interpretation of results that the seeds of dissatisfaction and disaster are sown. Here common sense is all important and mere scientific knowledge is at a discount. If the results of a series of small tests are not understood they may prove possitively dangerous. In a small test some of the conditions are under control while others are not. Temperature, proportion of liquid to solids, and speed of reaction are all matters of the utmost importance and may differ widely from actual practice, Calculations of costs from small tests are particularly dangerous. The relative losses of heat are much greater when working with small masses, and the effects of contact with air and the gases contained in the atmosphere are exaggerated as compared with working-scale tests. One deep-rooted skeptic is worth several optimists in this all-important part of the work. The distinctions between what is actual proof and what is the result of calculation must never be lost sight of.

The greatest amount of care will not entirely eliminate discordant results due to variations in samples and errors in analytical methods. For this reason the only safety lies in repetition and still more repetition. These errors are quite as apt to creep in when operations are on a large scale as with small quantities of material. For this reason ten small tests are better than one mil-run.

It is best to determine one point at a time and repeat that often enough so that there can be no doubt about the correctness of results. Then proceed to the next step. Bear in mind that all samples are tracherous, those from one kilo operations as well as those from a million ton mine, and that sampling is the basic operation in all testing.

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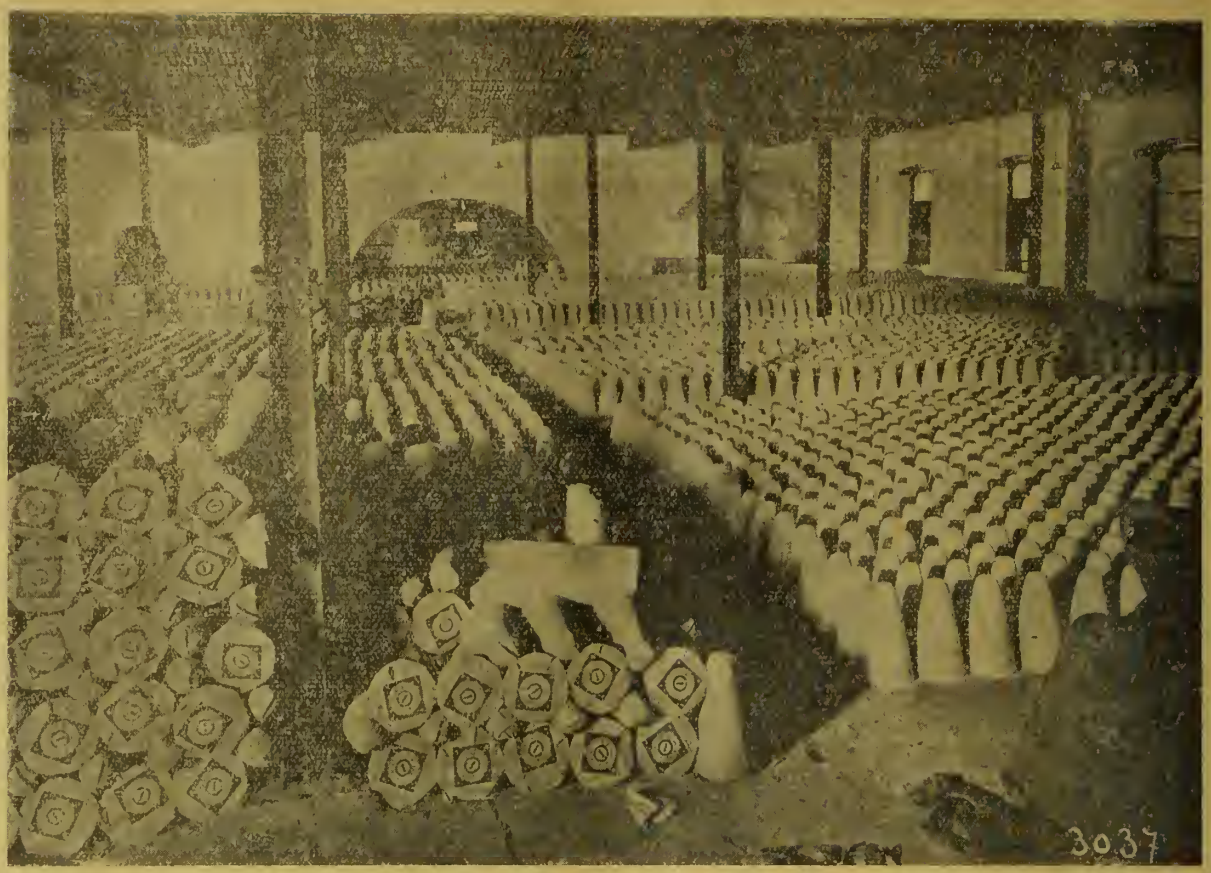
Nitrate exports from Chile, South America, in August and September totaled 1,362,189 and 2,119,881 quintals (1 quintal=101.61 lb.) respectively, against 4,313,476 and 4,118,906 quintals for those months of 1913.



Interior of a Sugar Warehouse in Mexico. Courtesy Mexico View Co.

Transporting Sugar from the Mill to the Railroads in Vera Cruz. Courtesy Mexico View Co.

At Home in the Hot Lands of Mexico. Courtesy Mexico View Co.

Wash Day in Mexico. Courtesy Mexico View Co.

Peruvian Tungsten Deposits.

The deposits of tungsten ore existing in the province of Ancachs, are described in an account of a tour of the mining districts of Salpo, Millhuachaqui, Quirivilca and Conchucos, published in **Peru To day.** Three companies are at work on the zone surrounding Mount Pelagatos. They are all situated at a high altitude, and the transport question is a serious problem. The mines of the Sociedad Minera Pelagatos are situated 14,850 feet, above the seam, and the lode is stated to give 30 per cent. copper and some silver with good tungsten values over an average of about 1 metro. The Sociedad Minera Wolfram's mine is at an altitude of 13,200 ft., and that of the Conchucos Copper & Tungsten Company, Limited, has erected a concentrating plant at about 12,000 ft. The ores in the two last mentioned concession carry only tungsten mineral. Somewhat lower down the river Chuquicarri is another group of properties on the Tamboras Mountain; the ore here consists of grey copper associated with tungsten mineral, as in the case of the Sociedad Minera Pelagatos mines. Technically, the chief problem is the concentration of the ores. There are stated to be immense deposits of low grade ores, but it has been impossible to extract more than 50 per cent. of the values, and even then the presence of iron pyrites is a great difficulty. At the Pelagatos mines the ore is crushed and panned by women, the copper ore being discharged into tanks and the tungsten concentrates collected in the pan. The copper ores are subsequently removed from the tanks and again panned and bagged ready for transportation.

In addition to the tungsten-bearing ores there are extensive deposits of copper, but nothing under about 40 per cent. is worth handling as things stand to-day.

Relative Economy of Gas and Steam Engines.

The gas engine under favorable circunstances is a reasonably cheap source of energy, particularly in the smaller units. The large internal-combustion engine has made an excellent record where blast-furnace gases are available. With natural gas or producer gas it does well in units of large size, but with gas of illuminating quality the economic outlook is not good, except in very small sizes. Producer systems of considerable size have been used abroad with fair success, and a number are giving good results in this country without, however, having obtained a sufficient reputation largely to increase their use. At present they seem to be of special rather than general applicability, but in some localities and with good care have shown excellent economy.

In the report of the National Electric Light Association committee on prime movers, it was made quite clear that in very large units the steam turbine can outrun even producer-gas-engine equipments in thermal efficiency, particularly at loads somewhat below the normal. In fact, at full load a 20,000-kw. turbine can operate at a thermal efficiency of 24 per cent in the turbo-generator itself, and with boilers as efficient as the large units tested in Detroit a year or two ago the efficiency will come very close indeed to 20 per cent from the coal to the electrical energy. Only the oil engine seems able to improve on this efficiency to any material extent, and the oil engine is limited to rather moderate sizes so far as the present outlook goes. In smaller units, say of 1000 kw, or 2000 kw., the tables are turned, and it is in such cases that the internal-combustion engines can more than hold their own.

It must not be forgotten, however, that the large steam turbine is not wihout a rival in steam efficiency. In the figures which have been repeatedly published, the efficiency of a first-class high-efficiency reciprocating-engine equipment of the locomobile type is equal to that of the large steam turbine. The locomobile is certainly capable of producing a B. H.P.-hour with 10 lb. of steam, which means less than 14 lb. per kw.-hr., a figure not easily reached in turbines of any moderate size up to the present time. While, therefore, the internal-combustion engine in units of moderate size cannot be left out of account in central-station economics, it is a question where they will stand when the smaller steam uints establish the efficiency that is within their reach.—**Electrical World.**

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*Safety Rules in Electrical Installations.**

Boxes, lined with approved non-combustible insulating materials, should be provided for all switches, fuses, current breakers or other bare parts exposed to the weather, dampness or contact with inflammable material, or where employees are liable to make accidental contact with live parts.

Conduits shall be considered as a mechanical and fire protection only, and not as an insulating medium. Provision should be made to prevent water getting in conduits. Only circuits carrying the same kind of current, at the same voltage, shall be run in one conduit.

Conductors should be of rail, bar, or structural shape wherever practicable, so located, protected or guarded as to minimise the danger to men working near them. Wherever practicable they should be painted yellow to distinguish them from ordinary structural work.

Circuit breakers of the contactor type or electrically operated should be used. Latches, blocks, &c., should not be used to prevent the circuit breaker from opening. Means should be provided to prevent unauthorised persons from changing the setting of the relays.

Disconnecting devices or switches should be provided for entirely disconnecting switchboards, oil switches, generators, etc., from all possible sources of power, including outgoing feeders, while men are working on them.

Fuses should be of the enclosed type.

Ground wires should be provided for frames and bedplates of generating machines, all electrically-driven machinery, motors, switchboard frames and railings, etc.

Lightning arresters should be located in easily accessible positions at a sufficient distance from wires and other inflammable material to prevent danger of fire, and should be protected by non-combustible barriers, and should be guarded so that employees cannot come into accidental contact with them.

Lighting.

Lamps of the arc type should be constructed as nearly as practicable of noncombustible material, and should be kept supplied with globes. No portion of the lamp outside of the globe and casing, except the binding posts, shall be live.

Series arc lamps, and lamps hung on structural supports, should have insulating supports and be not less than 20 ft. above the ground.

Tungsten lights should be used when possible.

Incandescent lamps or clusters of 150 watts capacity and over, with reflectors or shades, shall be suspended by a conduit, rod, or other substantial support, and should not depend on electrical feed wires for support.

Incandescent lights on 125 to 275-volt two-wire circuits should be carefully installed. Sockets of 500 vols should be used, of the porcelain composition, or weatherproof type, with glass or mica insulation. Brewery

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* From Inland Steel Company's Book of Rules.

cord and Duplex cable should be used for drop and portable lights and it is advised that wires be taped a distance of five inches above sockets. Switches should be double-pole, preferably of the knife type.

Portable lamps should be installed only where absolutely necessary, and then wire guards should be provided over the lamps where there is gas or other combustible material, or where the lamp is liable to be broken and explode.

Motors and Switches.

Motors should be railed off or otherwise guarded, wherever practicable, and armature shaft ends should be encased.

Rubber or wood-slat mats should be placed at the front of and in the back of switchboards.

Safety switches should be provided on all cranes, wherever the main switch and control is not within plain sight of the motor, and at all places where it is necessary for men to work out of sight.

Switches should be installed so that gravity will tend to open them rather than close them. Where practicable, switches should be mounted so that the blades are dead when the switch is open.

Automatic oil switches should be used in preference to air-break circuit switches on circuits of from 275 to 1,000 volts. In stations of 500 kw capacity and over there shall be remote control, either hand or electrically operated.

All panel switchboards should be of non-combustible material, such as marble or slate, mounted on metal framework, which shall be self supporting or rigidly braced. There should be not less than 4 ft. actual clearance between the equipment on the back of the board and the wall or other structures, and the ends of this space shall be guarded by railings or screens which will permit a clear view of the space back of the board. There shall be no doors, cupboards, stored material, or obstruction of any kind behind the boards, and this space shall not be used as a thoroughfare. No live parts carrying a potential of over 275 volts shall be mounted on the face of the panels.

All exposed parts carrying a potential of from 275 to 1,000 volts shall be painted blue, and those carrying over 1,000 volts shall be painted red, so as to make them easily distinguishable.

Warning signs shall be placed on all poles carrying a current of 275 volts or over. Where a lower current is carried on the same pole a high-tension danger sign shall be mounted on or immediately below the lowest crossarms carrying the high voltage.

Start-and-stop buttons or safety switches should be located at each machine so far as practicable.

On overhead transmission lines or open main wiring inside buildings, different types of insulators should be used for each separate class of service, so as to make circuits easily distinguishable for reasons of safety as well as for operation.

Wiring.

No live wire of any voltage shall be exposed in manholes.

Higher-voltage lines should always be located above those of lower voltage.

Lines should be installed so as to maintain a clearance of 22 ft. above standard-gauge tracks and yard level when supported on poles; when carried on viaducts, bridges, or other structures they should preferably be installed in conduits. When not installed in conduits on such estructures and when located above the structures they should be constructed to maintain a clearance of at least 8 ft. above the floor or walkway level. They shall in all cases be so constructed as not to project below the lowest part of such a rigid structure.

Wires carrying over 275 volts and less than 3,000 volts shall not be run on crossarms with lines carrying a greater or smaller potential. They should be kept as far as practicable away from windows, platforms, and other places where unauthorised persons can come in contact with them.

Feed wires above 275 volts shall not be carried through buildings, except where power is supplied to machinery therein, and in all cases should be of either conduit or underground construction.

Open or exposed mains shall be located so as to prevent injury to men having occasion to work in their vicinity.

No wiring shall be laid on top of floors, as it is liable to trip someone, and in connection with extension lights, the latter are liable to be pulled from their positions and explode.

All wires used during construction work and for all temporary purposes shall be removed as soon as the work is completed. If this cannot be done at once, the ends of the wires should be taped, to prevent possible short circuiting, and a danger sign should be attached thereto.

Flexible cord for lamps should not be tied on iron rods or allowed to come in contact with water or oil.

An interesting tin mineral was found in Butte during the past year, and it was first discovered in the Colusa vein, one of the early locations of the distrit. It has been called colusite, according to C. W. Goodale. A part analysis of one specimen is as follows: Cu, 46.1 per cent.; Fe, 1.8 per cent.; S, 28.4 per cent.; As, 6.5 per cent.; Sb, 2.5 per cent.; Sn, 6.6 per cent.; Te, 3.1 per cent.; Au, 7.55 oz.; and Ag, 15.80 oz. per ton; total, 95.0 per cent. The appearance of the mineral in a polished section under the microscope leads to the conclusion that it is complex, perhaps a mixture of stannite, tetrahedrite, a telluride of gold, and other minerals. Ten specimens have been analysed, including several from the Mountain View Mine, and variations in compositions are found, so that further study may show that it is not entitled to a name for a new mineral.

Determination of Antimony and Arsenic in Alloys. —From 1 to 10 gm. of the metal are heated with 20—60 cc. of sulphuric acid until any precipitated sulphur has redissolved and sulphur dioxide has been completely expelled, the solution is diluted with its own volume of water, and arsenic and antimony determined together by titrating the boiling solution with permanganate (the iron factor of the permanganate multiplied by 1.0714 gives the equivalent amount of antimony and arsenic in terms of antimony). Another portion of the metal is heated with ferrous sulphate and hydrochloric acid, and arsenic determined in the distillate with iodine solution as usual. If much iron be present, it must be determined separately and deducted from the antimony-arsenic result. Tin, bismuth, and zinc do not interfere with the determination, nor does copper unless present in such quantity that its colour affects the end point in the permanganate titration.—L. Bertiaux, Ann. Chim. analyt.

Solubility of Silica in Acids. — When hydrated silica is evaporated to dryness with hydrochloric acid, the residue heated to 110° C., and the silica separated in the usual way, about 0.75 per cent remains in solution, but may be recovered by evaporating the filtrate to dryness and collecting the insoluble residue thus obtained. Similar results are

found when nitric acid is used, but, owing to the difficulty of removing all the nitric acid by washing, there is a tendency for the results to be too high. About 3.5 per cent of the weight of the silica remains in solution when sulphuric acid is used (in this case, the mixture cannot be evaporated to complete dryness), but the loss is recovered by a second evaporation. Hydrated silica was found to dissolve in dilute hydrochloric acid of various strengths (1:2; 1:1; 2:1) to the extent of from 0.03 to 0.33 gm. per litre, the largest quantity being dissolved at 100° C. by the 2:1 acid. Nitric and sulphuric acids dissolved smaller quantities, namely, from 0.02 to 0.1 gm. per litre. W. Wunder and A. Suleimann, Ann. Chim. analyt.

Disadvantages of Short Fuse.

The object for using fuse for igniting explosives is to allow the charge to be thoroghly tamped and confined, and after lighting the exposed end to allow the miner ample time to get to a place of safety before the charge explodes. To fulfil its whole object, the fuse must extend from the charge far enough out of the drill hole to allow time for the blaster to "take cover" after lighting the fuse. The fuse must extend to the collar so that the tamping may be done thoroughly, otherwise the whole of the explosive power is not realised and money value in explosive is thrown away.

Some miners cut the fuse attached to the cartridge so that it is a foot long or less, then light the fuse, and while it is sputtering ram the cartridge into the hole, and run. They may, sometimes, throw in a light tamping, but their time is too short to tamp the charge, as the locality is distinctly unhealthy for the time being.

Why do they do it? To save fuse, which costs from a third of a cent to a cent a foot.

By using a foot of fuse instead of 2 or 4 ft. they save from 1 to 3 cents worth of fuse, but they waste as much or more than this, because from lack of proper tamping only a part of the explosive power of the dynamite is realised. In the open, a foot of American fuse takes about 30 seconds to burn, but in the bore hole, even when tamped hurriedly and incompletely, it is liable to burn faster.

What good will it do the miner to save a few cents a day on fuse while he is wasting several cents a day on dynamite?

This practice of using "short" fuse is wasteful of explosives, is dangerous, and in the long run will injure or kill the miner.—**Dupont Magazine.**

Care of Mine Timber.

The Colliery Engineer, gives the results of experimental work done by the Delaware, Lackawanna & Western Railroad Co., in timber treatment tests. In a certain place in one of the Kingston mines where timbers lasted only about six months, the pit timbers were replaced with creosoted loblolly pine, and in between these timber sets were placed others of the same kind of wood that had been peeled and seasoned. In the same locality loblolly pine sticks treated with lime were placed so that they would be subject to the same general conditions. These timbers lasted for about five years and all seemed to be sound. At the end of the sixth year, however, the lime-treated sticks were decayed to such an extent that they were replaced with timber treated with creosote and chloride of zinc. The simple lime treatment which increased the life of the timber from six months to six years shows how necessary it is to care for mine timber and the economy of so doing, for the creosoted timbers are practically sound after seven years.

Mines of Ecuador.

Gold is mined in a crude manner by the Indians of the Andes, but the old silver mines have been abandoned. Mines worked by the ancients are frequently to be seen, which, from their extent, show them to have been of considerable importance, in many instances the tunnels being in a fair state of preservation. At the present time the only gold mine in operation is owned by an American corporation, and is located in the Province of Oro, where gold has always been known to exist in profitable quantities. During 1912 the company shipped to the United Sstates gold in the form of bullion and concentrates to the value of $357,079, and in 1913 $289,133. A French company has large holdings near Zaruma, but development work is not very active.

Titrating Zinc in Presence of Lead.—Concerning the influence of lead in the titration of zinc with ferrocyanide, V. Lenher and C. E. Meloche state in the "Journal of the American Chemical Society" that, in titrating lead by the ferrocyanide method, acetic acid solution must be used, and mineral acids must be absent. For this reason, lead does not affect the ordinary ferrocyanide titration of zinc, in which hydrochloric acid is usually present. In the technical examination for zinc of ores containing lead, iron, &c., the lead need not be removed. Five-tenths gram of the sample is dissolved in 10 ccms. of hydrochloric acid and a little nitric acid, the solution is diluted, iron, &c., precipitated by excess of ammonia, the precipitate is filtered off, redissolved in hydrochloric acid, reprecipitated, filtered and washed, and the combined filtrates acidified with hydrochloric acid and evaporated down to about 200 ccms. The solution should contain about 10 gms. of ammonium chloride and 6 to 10 ccms. of hydrochloric acid, and should be titrated hot.

Most of the manganese ore consumed in the United States is imported from British India, Brazil and Russia, and smaller amounts from France, Germany and other countries. This ore is used largely in the manufacture of iron-manganese alloys, such as spiegeleisen, ferromanganese, silverspiegel and silicomanganese. Spiegeleisen and ferromanganese are used largely in the manufacture of steel as reducers and recarburizers. A considerable quantity of high-grade ore is used as a depolarizer in the manufacture of dry-cell electric batteries.

Cathodic Determination of Lead.—R. Gartenmeister, in "Chemiker Zeitung," No. 125, 1913, describes a process for the cathodic determination of lead and the analysis of lead alloys. In the quantitative separation of lead at the cathode by the electrolysis of the nitrate, a depolariser is necessary to prevent the formation of lead peroxide at the anode and the evolution of hydrogen at the cathode. For this purpose the author suggests the use of gallic acid and alcohol. For each gram of lead a total volume of electrolyte of about 125 ccms., containing 2 to 2:5 ccms. of free nitric acid (sp. gr. 1:4), 5 grams of gallic acid, and 5 to 6 ccms, of alcohol. Under these conditions copper (completely), silver, tin, arsenic, antimony, and bismuth are also deposited. For alloys containing lead, tin, and antimony the lead is first precipitated as sulphide in alkaline solution. After washing with sodium sulphide and ammonium chloride containing a little sulphide, the precipitate is dissolved in nitric acid, the filler is incinerated and the ash also dissolved, and after evaporation to dryness the electrolyte is prepared as above. In analysing ordinary commercial alloys it is then only necessary to correct for any copper contained in the deposit lead.

PATIO.

It has been shown recently that the combustion of coal is not the simple reaction resulting in oxides of carbon and in water given in most text-books. In the early stages of the oxidation of coal an unknown complex of the coal substance and oxygen is formed. As the heat rises this complex is dissociated into water, carbon dioxide and carbon monoxide. Below 200 deg. water is the chief product of this dissociation, the proportion of carbon dioxide increasing as the temperature rises. Carbon monoxide is a primary product of the oxidation of coal at temperatures between 100 and 300 deg. C, and possibly also outside this range.

In a steam stamp mill recently built in the Lake Superior district, the concrete foundations for the mortars was placed on a sand botton. Excavation was continued to about 55 ft. below the intended plane of the stamp base. A concrete caison ring was let down and mushroomed at the bottom with fresh concrete and the ring filled. This block of concrete supports the stamp weighing about 115 tons. The total weight resting upon the sand is about 1050 tons including 935 tons of foundations. It is calculated that the skin friction against the sides of the block will take care at least 400 tons of the total weight leavin 650 tons to be supportd by the bottom having 314 sq. ft. or a load of a little over 1.25 tons per square foot.

H. Garland describes a bronze knife found in Egypt and supposed to be 3500 years old. The original cored structure is still plainly evident. The view is held that the knife was hammered cold and so the best cutting edge was obtained. The crystal grains are very small, there having apparently been no crystal growth during the centuries since the metal was worked. This shows either that recrystallization does not take place at ordinary temperatures, or if it does, much more than 3500 years is required to effect the change.

Mineralogical investigations have shown two sources which contain uranium and radium in sufficient quantities and of which there are large enough deposits to justify their commercial working. These are pitchblende and carnotite. While there are considerable deposits of monazite, the thorium mineral which also at times carries small amounts of uranium, its comparatively low radioactivity eliminates it from becoming a true source of radium production. Up to recent years pitchblende has been the only commercial source of radium, but lately carnotite has become more important.

Ores sold for the extraction of radium must contain a minimum of 2 per cent of uranium. The proportion of radium to uranium is only about 1 to 2,600,000. There is at present no considerable market for uranium, and for every gram of radium produced it is necessary to separate more than 2.5 tons of uranium now a practically unsaleable by product.

Highly refined osmium and platinum have been combined in varying proportions yielding alloys of commercial value. While the two metals may be combined in almost any proportion, alloys containing from one to ten per cent of osmium are chiefly used. Great purity of the components is essential, as the presence of small precentages of other metals or elements appear to be very detrimental to the properties of the resulting alloy. The osmium-platinum alloy is very resistant to acids, its electric resistance is higher than that of the iridium-platinum alloy, and posseses great hardness and tensile strength. Wires of the finest sizes are drawn with comparative ease.

To produce dense, solid, and coherent electrolytic deposits of lead from acetate solutions various addition agents are introduced into the electrolyte. Peptones seem to give the best results in acetate solutions. Among others that have been studied are, extract of feathers, casein boiled in acetic acid, casein modified by digestion with enzymes, tannin, meat extracts, vegetable extracts, oils and gums. It is probable that with the proper addition agents solid, coherent deposits may be electrolyzed from any soluble lead salt.

Gelasio Caetani calls attention to the fact that the object of ore treatment is not to attain the highest metallurgical efficiency, and that high percentage of recovery is not necessarily an index to the efficiency of the metallurgical plant. Metallurgical recovery and economic recovery are not of equal importance; the latter is of paramount importance, being the sole object of the plant. Economic efficiency is the resultant of several factors, chief among which are: first, metallurgical efficiency; second, freight and transport charges; third, smelter schedule; and fourth operating costs.

The cost of concentration varies with the ore to be concentrated and with the object to be gained by concentration. In cases where a complete separation of certain portions is required it may be necessary to accomplish concentration in two or more steps, the first one being more or less a roughing-off system, followed by classification and reconcentration. In other cases, however, where the ore justifies the practice, the main object is to remove the coarser pyrites and metal-bearing sulphides, leaving the finer portions to be treated along with the rest of the ore. In this case, complicated methods are not necessary, and concentration may be comparatively inexpensive.

The Barramia mine, an ancient Egyptian mine worked for gold, it is estimated as along ago as 3000 years B. C., is now again operated with profit by an English company. The workings were evidently at one time very extensive and the ancient methods of working are plainly shown in the old stopes and crosscuts. Instead of timber supports pillars of cut stone were used, the excavation being performed mainly by cutting tools without fire.

The Copper Queen smelting works at Douglas, Ariz. treated during 1913 more than a million tons of ore, producing 133,410,582 lb. of copper besides more than $1,500,000 worth of gold and silver.

A novel way of disposing of converter slag is employed at the Copper Queen smelter. This slag is used for fluxing the blast furnaces, and formerly 45 Mexicans were needed to break up and load the material for transportation to the feed floor. Now the slag is hauled in the molten state to the side of the ore bins and poured over the beds. When the layer of slag becomes too thick, more ore is unloaded into the bin. Layers from one to two inches in thickness are found to give no trouble in excavating the material with steams shovels.

The following method of smoothing out old mounted plans or drawings is given in Engineering News:—Make a thick paste by boiling flour and water down to the consistency of thin dough. Lay the plan out bottom up on a flat surface and apply the paste as a paint, rubbing it thoroughly into the surface. Keep the plan perfectly flat until dry, after which it will remain smooth. The paste, if thick enough, will not injure the drawing.

Although amalgamation is now seldom used in cyanide mills, there are some cases in which its use is advisable. If the ore contains coarse gold amalgamation is often necessary; but when amalgamation is not necessary and can be avoided its use would only involve an added expense.

A new record for fast tunnel driving has been made by the Canadian Pacific under the Selkirk mountains. The tunnel is 7½ by 10 ft. in section and is driven through slate containing quartz stringers. For the 30 days work from Nov. 1 to Dec. 1, the advance was 817 ft. The average per day was 27.84 ft. and the best day's advance was 817 ft. The average per day was 27.84 ft. and the best days advance was 37 ft.

A new process for agglomerating fine dust from iron blast furnaces has been patented in Colorado. A pipe with a point provided with fine holes like a driven-well point is driven into the heap of dust, and a thin mixture of cement or lime is forced through until the bottom of the pile is saturated. The pipe

is then raised slightly and the next layer treated. So on until the whole pile is treated. After a sufficient set the mass can be broken up into lumps without falling into powder.

To minimize the rotting of the canvas under the wires on Oliver filters, in one mill the wire before winding is coated with P. & B. paint, by passing the wire under a grooved wheel below the surface of the liquid paint.

At the Alaska Gold Mines mill the system follows the practice developed in the treatment of disseminated copper ores rather than standard gold mill practice. Breaking is to be followed by rolls, roughing tables, classifiers, regrinding plant, and concentrators, the aim being for high concentration efficiency rather than high extraction by amalgamation.

The increase of the weight of stamps seems to have reached its limit. Some of the largest operators now hold that 1250 lb. is the limit consistent with both efficiency and economy.

A method for estimating the tonnage of ore treated in mills which seems likely to replace the usual weighng and count of cars, takes into account the specific gravity of the pulp handled. The flow of pulp known, it is easy to calculate the total weight of ore handled by means of the volume and specific gravity.

An old method for the direct estimation of silver in gold bullion has been revived in the San Francisco mint. This method suggested by Balling and developed by Whitehead, consists in alloying with cadmium, dissolving in nitric acid and titrating with sulphocyanide solution.

Plans are under way for the construction of coal-dust fired reverberatories for copper smelting with dimensions up to 25 ft. by 175 ft. These immense furnaces are intended to replace the blast furnaces in the plant entirely, and will eliminate many of the difficulties involved in the reduction of concentrates from disseminated ores.

New Publications.

Iron Ores, Their Occurrence, Valuation and Control. By Edwin C. Eckel. McGraw-Hill Book Co., New York. Price $4.00.

Modern Tunneling, With Special Reference to Mine and Water Supply Tunnels. By D. W. Brunton and J. A. Davis. John Wiley & Sons.

Unit Construction Costs from the Smelter of the Arizona Copper Co. By E. Horton Jones. McGraw-Hill Book Co., New York. Price $2.00.

American Handbook for Electrical Engineers, compiled by a staff of specialists, Harold Pender, editor in chief; 2023 pages, 4×7 in.; thin paper, leather bound. John Wiley & Sons, New York. Price $5.00.

Contributions to Economic Geology, 1912 (Short papers and Preliminary Reports) Part 11—Mineral Fuels. By Maurice R. Campbell and others. U. S. Geological Survey, Bulletin 541, 532 pp; illustrated.

Annual Report of the Director of the Mint for the Fiscal Year Ended June 30, 1914. Also the Production of the Precious Metals in the Calendar Year 1913. Washington, D. C.; Treasury Department. Pp. 281; illustrated.

Notes on the Sampling and Analysis of Coal. By Arno C. Fieldner. Washington, D. C.; U. S. Bureau of Mines. Technical Paper 76; pp. 61; illustrated.

These notes on the sampling and analysis of coal apply particularly to coal in place in a mine or outcrop and are intended to supplement information already published by the U. S. Geological Survey and the Bureau of Mines.

A Study of the Oxidation of Coal. By Horace C. Porter and O. C. Ralston. Washington, D. C.; U. S. Bureau of Mines. Technical paper 65; pp. 30; illustrated.

Quarry Accidents in the United States During the Calendar Year 1913. Compiled by Albert H. Fay. Washington, D. C.; U. S. Bureau of Mines. Technical paper 92; pp. 76.

Slate in the United States. By T. Nelson Dale and Others. Washington, D. C.; U. S. Geological Survey. Bulletin 586; pp. 220; illustrated.

This bulletin is divided into three parts. In Part I is set forth the present state of scientific knowledge as to origin, structure, texture, and chemical and mineral composition of slate. In Part II are described the slates and quarries of each district. Part III treats of the economic geology of slate, including the scientific prospecting for slate, methods of testing, slate machinery, uses of slate, etc.

Gems and Precious Stones in 1913. By Douglas B. Sterrett. Washington, D. C.; U. S. Geological Survey. Mineral Resources of the United States, calendar year 1913; II: 30; pp. 62.

Mineral Resources of Alaska—Report on Progress of Investigation in 1913. By Alfred H. Brooks and Others. Washington, D. C.; U. S. Geological Survey. Bulletin 592; pp. 413; illustrated.

The Production of Platinum and Allied Metals in 1913. By David T. Day. Washington, D. C.; U. S. Geological Survey. Mineral Resources of the United States, calendar year 1913; I:16; pp 14.

Gold, Silver, Copper, Lead and Zinc in New Mexico and Texas in 1913—Mines Report. By Charles W. Henderson. Washington, D. C.; U. S. Geological Survey. Mineral Resources of the United States, calendar year 1913; I:15; pp. 30.

The Production of Cobalt, Molybdenum, Nickel, Tin, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1913. By Frank L. Hess. Washington, D. C.; U. S. Geological Survey. Mineral Resources of the United States, calendar year 1913; I:13; pp. 67.

The Shinumo Quadrangle, Grand Canyon District, Arizona. B. L. F. Noble, Washington, D. C.; U. S. Geological Survey. Bulletin 549; pp. 100; illustrated.

Contains considerable lithologic, stratigraphic and descriptive matter pertaining to the Grand Canyon of the Colorado in Arizona.

Statistics of the Clay-Working Industries in the United States in 1913. By Jefferson Middleton. With Notes on the Occurrence and Use of Flint Clay. By J. H. Hance. Washington, D. C.; U. S. Geological Survey. Mineral Resources of the United States, calendar year 1913; II:29; pp. 106.

United States Coals Available for Export Trade. By Van H. Manning, Washington, D. C. U. S. Bureau of Mines. Bulletin 76; pp. 15; illustrated.

Describes briefly the general characteristics and commercial quality of some of the coals mined in the United States that reach tidewater ports, and shows in a general way the important characteristics of those coals that by reason of transportation facilities and the situation of the coal fields are most available for export.

Coal Gas Residuals. By Fred H. Wagner. 180 pages, 44 illustrations. McGraw-Hill Book Co., New York City. Price $2.00.

Metallurgy of Copper. By H. O. Hofman. XIV+556 pages. 548 illustrations. McGraw-Hill Book Co., New York City. Price $5.00.

Compressed Air Practice. By Frank Richards. McGraw-Hill Book Co. New York. Cloth, 326 pages, 6×9 ¼ in.: 96 illustrations; tables. Price $3.00.

The Chamber of Mines and Oil of Los Angeles Calif., has begun the publication a new monthly, the Oil and Mining Bulletin, as a means of boosting the interests of the Los Angeles region.

An Extention of the Dewey Decimal System of Classification applied to the Engineering Industries. By L. P. Breckenridge and G. A. Goodenough. Originally

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ASK FOR CATALOGUE.

issued as Bulletin No. 9, in 1906, and still published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Price 50c.

The filing and classification of engineering data has become a matter of much importance, and this bulletin was prepared for use as a guide in carrying out such work. The original edition of this bulletin was subject to the usual gratuitous distribution and the demand was such that a second edition was printed and distributed. The demand continuing, a revised edition, much extended as compared with the original edition, was printed in the fall of 1912. This edition was limited and is subject to gratuitous distribution. It presents subdivisions of subjects in such detail as to constitute a complete classification for most engineering industries, even though they are highly specialized. The revision has been made in acordance with the 1911 edition of "Decimal Classification" by Melvil Dewey.

Gold and Silver in 1913—General Report. By H. D. McCaskey. U. S. Geological Survey, Washington, D. C.

Gold, Silver, Copper, Lead and Zinc in Arizona in 1913—Mines Report. By V. C. Heikes, U. S. Geological Survey, Washington, D. C.

Source, Manufacture and Use of Lime, by Ernest F. Burchard and Warren E. Emley. U. S. Geological Survey, Washington, D. C.

Gold, Silver, Copper, Lead, and Zinc in Nevada in 1913—Mines Report. By V. C. Heikes. Washington, D. C.; U. S. Geological Survey. Mineral Resources of the United States, calendar year 1913, I :25, pp. 42.

Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington in 1913—Mines Report. By C. N. Gerry. Washington, D. C.; U. S. Geological Survey. Mineral Resources of the United States, calendar year 1913, I :24; pp. 50.

Deposits of the Useful Minerals and Rocks, Vol. 1. By. F. Beyschlag, J. H. L. Vogt and P. Krusch. 514 pages, illus. MacMillan &Co., London. $5.00.

PERSONALS.

C. E. Rhodes, D. C. Barnard, H. L. Thorne, John W. Doyle and Gray Drummond, all of El Oro, were recent visitors in Mexico City.

Gray Drummond is leaving for England to enter the British naval service. His position as superintendent of construction for the Dos Estrellas company will be taken by Mr. Phillips.

Guy Baldwin will leave for the United States soon.

Jas. F. MacNabb has returned to Mexico City from the mining camps of Jalisco.

Carlos Van Law, manager of the Real del Monte company, is in Mexico City.

H. F. Grondys, representative of the Cia. Minera de Oruro, Oruro, Bolivia, has been in Salt Lake City investigating metallurgical conditions.

A. E. Keller, of Denver, Colo., has gone to Ecuador to revise the mining and metallurgical accounting system for the South American Development Co.

Walter Harvey Weed has announced the removal of the office of the Copper Handbook from Houghton, Mich., to New York City.

Gerald Galt has joined the staff of the Braden Copper Co., in Chile.

Ernest Stein is with the Rosario Mining & Milling Co., in Durango.

Arthur O. Christensen, formerly of Sombrerete, Zac., is now at Franklin, N. J.

W. C. Leaming is with the Cia. Minera del Picacho at Bacoachi, Sonora.

B. J. Silbert is with El Tigre company at Esqueda, Son.

Frank M. Estes is manager of the Creston Colorada company at Torres, Son.

Geo. A. Morrison, mining engineer, has returned to Mexico City from a trip to Queretaro.

Colon Timmons is with the Atlas Consolidated Mines Co., at Tuttletown, Calif.

Syd D. Kempton, formerly at Barranca del Oro, Tepic, is now with the Warsaw Mines, Old Glory, Arizona.

John Watson is operating the La Caridad mine at Nacozari, Son. He has operated steadily throughout the revolution without having been molested in any way nor having had to close down for a single day.

C. A. Lantz is in New York. He will return to Mexico shortly.

Milton Booth, formerly in charge of the Santa Gertrudis mill at Pachuca is in New York.

A. F. Bennett, mining enginer with offices at 2 Rector St., New York, is in Sonora on mining business.

Frank Hazelwood is in El Paso, Texas.

Custer McKay has returned to Zacatecas from the States.

Fred T. Fox is in Porto Rico representing a Texas Oil Co.

Andrew Ennis has returned to Guananajuato from Los Angeles, Calif.

H. H. Burhans is with the South American Development Co., at Zama, Ecuador.

Pat Ryan is in Chihuahua.

Blamey Stevens has returned to Mexico from England.

John M. Nichol has gone to Nicaragua.

A. E. Parker has returned to England from Colombia.

Malcolm Roberts has returned to Bolivia.

W. E. Simpson is in Mexico City.

H. G. D. Dixon has returned to England from Venezuela.

L. B. Godin has returned to Mexico City from Vera Cruz.

W. H. Armstrong is with Zubrian & Co., Mexico City.

Arthur Kingsford is in England.

Eugene Bailey, formely with Braniff & Co., has gone to England.

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The Copper Industry and the European War.

That the copper industry will be one of the chief sufferers of the American metal industries is fully appreciated in that country. During the last five years, according to Geo. Otis Smith, director of the U. S. Geological Survey, approximately 50 per cent, of the copper. turned out by American refineries has been exported almost entirely to the countries now involved in the European war. Some of this copper has been imported for metallurgical treatment, and the imports will probably be somewhat restricted on account of shipping conditions. During these five years, however, domestic consumers have taken only about 63 to 67 per cent. of the copper produced from mines within the United States, so it is evident that there must be a material curtailment of production while present conditions prevail. Considerable copper is, of course, consumed in munitions of war and for other military purposes, but the constructive arts of peace are decidedly more favourable for the copper industry than the destructive art of war. It is stated that the American producers have already greatly curtailed their production, and it seems almost certain that the output must be materially restricted for an indefinite period, the length of which will depend largely on the European conditions. It is considered that the opportunity for the American manufacturer lies in entering the foreign markets that were largely supplied by European exports of manufactured goods. The capacity of the domestic manufacturing plants has not been strained to meet consumption, and the plants have not been operated to full capacity, so that as far as manufacturing facilities are concerned they are able to supply a large part of any demand from South America, Africa, China, Australia, and other countries.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61 642	57 506	27.190	28 357	26.578
March	58.375	57.870	58.067	26.875	26 669	26.788
April	59 207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58 175	28.038	27.825	26.704
June	61.290	58.990	58.471	28.215	27.199	26.948
July	60.654	58.721	54.678	27.919	27.074	25.219
August	61.606	59.293	54.344	28.375	27.335	25.979
September	63.078	60.640	53 290	29.088	27.986	24.260
October	63.471	60.793	50.654	29.299	28.083	23.199
November	62.792	58.995	49.082	29.012	27.263	22.703
December	63.365	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16 767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14.672	61.603	14.871	.....	87.140	66.274
July	14.190	13.223	14.563	.....	64.166	64.955
August	15.400	.....	15.904	.....	69.200	53.227
September	16.328	.....	16.799	.....	73.125	.....
October	16.337	.....	16.913	.....	73.383	.....
November	15.182	11.739	16.022	.....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1913	1914	1913	1914
January	50.298	37.779	238.273	171.905
February	48.766	39 830	220.140	181.555
March	46.832	38.038	213.615	173.819
April	49.115	36.154	224.159	163 963
May	49.038	33.360	224.143	150 702
June	44.820	30 577	207.208	138.321
July	40.260	31.707	183.511	142.517
August	41.582	...	188.731	.....
September	42.410	32. 875	193.074	.....
October	40.462	30.284	184.837	.....
November	39.810	33.304	180.869	139.391
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound sterling per long ton.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.850	15.977	19.651
April	4.381	3.810	4.242	3.683	17.597	18.225
May	4.342	3 900	4.226	3.863	18.923	18 503
June	4.325	3. 900	4.190	3.810	20.226	19.411
July	4 353	3.891	4 223	3.738	20.038	19 051
August	4.624	3 875	4.550	3.715	20.406	
September	4.698	3 828	4.579	3.658	20 648	
October	4.402	3.528	4 .253	3 384	20.302	
November	4.293	3.683	4.146	3.585	19.334	18.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	6. 931	5.262	6.854	5.112	26.114	21.583
February	6.239	5.377	6.089	5.227	25.338	21.413
March	6.078	5.220	5.926	5.100	24.605	21.460
April	5.641	5.113	5.491	4.963	27.313	21.569
May	5.406	5.074	5.256	4.924	24 583	21.393
June	5.124	5.000	4.974	4.850	22.143	21.345
July	5.278	4.920	5.128	4.770	20.592	21.568
August	5.658	5.568	5.508	5.418	20.706	
September	5.694	5.380	5.444	4.230	21.148	
October	5.340	4 909	5.188	4.750	20.614	
November	5.229	5.112	5.083	4.962	20.581	25.018
December	5.156		.004		21.214	
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

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TRADE NOTES

Bernard MacDonald, formely of Guanajuato, has recently patented in the United Sstates an acid proof air nozzle and valve for use in the agitation and pumping of pulps undergoing treatment in acid solution and for the pumping and transference of acids throughout the plants.

Lane & Bodley Co., Cincinnati, Ohio, has issued Catalogue Form 28 of 28 pages, illustrating and describing the heavy duty and Columbian Corliss engines manufactured by this company. The heavy duty engines are built in various capacities of from 130 to 2200 indicated horse power. The Columbian Corliss engines have capacities of from 32 to 535 indicated horse power.

S. Flory Mfg. Co., Bangor, Pa., has issued an attractive booklet of 16 pages illustrating installations in use in the construction of the Kensico dam at Valhalla, N. Y.

Lagonda Mfg. Co., Springfield, Ohio, manufacturers of boiler tube cleaners and scale removing apparatus, has issued a bulletin entitiled "Lagonda Boiler Tube Cleaners" which fully describes their line of tube cleaners.

Koering Cyaniding Process Co., Detroit, Mich., has perfected arrangements whereby this process is about ready for operators of cyanide plants. The process consists of a revolving drum and basin, the former under heat and pressure.

Lidgerwood Mfg. Co., New York, has built more than 37,000 steam and electric hoists during the 40 odd years that the company has been in business.

Joseph Dixon Crucible Co., Jersey City, N. J., has issued a 20 page pamphlet entitled "Useful Spanish Words and Phrases."

Ludlow-Saylor Wire Co., St Louis, Mo., published an illustrated catalogue of 77 pages descriptive of the "Perfect Double Crimped Wire Cloth" manufactured by this company. It is claimed that the "Perfect" screen will give service until the wire is worn too thin to retain the weight of the material being screened, this feature being due to the double crimping, which keeps the wires in their original position until worn through.

Nordberg Mfg. Co., Milwaukee, Wis. Bulletin No. 23 illustrates and describes the Company's line of steam and compressed air mine hoists, which range from small hoists for development work to the largest drum and reel hoists for hoisting heavy loads from deep shafts. Among the hoists illustrated is what is claimed to be the largest hoist in the world, being one of two 4-cylinder hoists built for the Tamarack Mining Co., of Michigan, having a total rope pull of 42,000 lb. and hoisting speed of 6000 ft. per minute.

The Garlock Packing Co. has recently moved their offices to new quarters on 1ª Gante 14, Corner 16 de Septiembre, where they have complete samples of all packings they manufacture. The large demands these packings have had is the best proof of the quality and the general satisfaction this packing will give. The Company has factories and stores in all the principal cities of the United States, and of Europe, in order to meet the demands of its numerous customers and has operated for many years a factory in Denver, Colo. which supplies all the mines and smelters of that region of the United States and of Northern Mexico.

Industrial Instrument Co., Foxboro, Mass., has issued Bulletins Nos. 86 and 91. The former describes the Foxboro differential recording gauges and orifice meters for measuring the flow of gases. Bulletin 91 describes the Foxboro recording and indication dial-type thermometers.

Data Concerning Platinum, the well known illustrated booklet, published by Baker & Co., Inc., Newark, N. J., has appeared in its thirteenth edition, with numerous new tables, illustrations and matter descriptive of various new appliances of platinum. There are 53 pages of descriptive matter of platinum stills for the concentration of sulphuric acid, platinum dishes, platinum parting apparatus, retorts, crucibles, combustion tubes, muffles, triangles, filter cones, platinum and platinum gauge electrodes, tongs, rods, etc. Concise useful rules follow on the use and care of platinum ware, as well as extensive tables of weights of platinum ware, sheet and foil conversion tables, sulphuric acid tables, tables of specific weights, boiling points, etc. The whole book comprises 80 pages and is interestingly written and neatly printed and illustrated.

Wood Drill Works, Paterson, N. J. Wear and tear upon drills has possibly been greater than upon any other tool, and therefore anything that increases its durability is most desirable. To increase the life of the Wood drill the company decided to change the construction of the cylinder chest and air head of the drill from ordinary cast iron to vanadium tungsten iron, which it is claimed adds very materially to the life of the drill. A recent catalogue of the Company describes in detail the construction and operation of the drills manufactured by this Company.

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Ensaye del Platino Crudo

El platino crudo existe en el mercado en la forma de pepitas que varían de peso de -00 milígramos abajo. Puede dividirse en dos porciones el insoluble y el soluble en aqua regia. El insoluble incluye el osmiridio como su único constituyente valioso, mientras el soluble incluye el platino, el iridio, el paladio el rodio y el cloro. Se desea determinar con exactitud cada uno de los metales antes indicados.

Este método original lo tiene actualmente en uso uno de los compradores en grande de platino crudo y ha sido comprobado por los resultados obtenidos al refinar los lotes crudos comprados.

El método.—Pésense 25 gramos de la muestra en un vaso de análisis. Agréguense 200 c. c. de aqua regia, (1 parte de ácido nítrico por 3 partes de ácido hidroclórico por volumen), y colóquese en el baño María durante una hora y en seguida póngase en un pedazo delgado de asbestos en la placa caliente y hiérvase lentamente durante dos horas. Quítese de la placa caliente y déjese asentar durante 15 minutos. Decántese la solución dentro de otro vaso de análisis de 300 c. c. y hiérvase nuevamente durante una hora hasta disolver cualquier cantidad que exista de metal finamente dividido, el cual puede decantarse. Quítese de la placa caliente y llénese el vaso de análisis con agua. Agítese bien y déjese asentar durante una noche. Inmediatamente después de decantar el aqua regia del vaso de análisis original agréguense otros 200 c. c. de aqua regia al residuo existente y repítase la operación del calentamiento y hervido del ácido. Finalmente quítese de la placa, llénese con agua, agitese y déjese asentar durante una noche. A menos que el mineral esté en pedazos grandes, lo cual no es lo común, la solución de los minerales solubles será completa con este procedimiento el cual está calculada su duración en un día.

Decántese la solución clara de ambas vasijas en un frasco volumétrico de 1,000 c. c., teniendo cuidado de no permitir que lleve nada de los insolubles. Lávese el contenido de uno de los vasos en el otro de manera de juntar en un solo vaso y para diluir el ácido antes de la filtración. Filtrese en un filtro de papel de 9 cents. en un frasco de 1,000 c. c. Lávese el insoluble del vaso en el papel y luego lávese en el papel hasta que la solución que pase a través esté perfectamente incolora.

Determinación del osmiridio.

Pásese el papel-filtro y su contenido a un escorificador de 2½ pulgadas; agréguense 10 a 15 gramos de plomo de probar, llénese el escorificador por completo de litargirio y fúndase en la mufla durante media hora. Déjese enfriar el escorificador, quiébrese y sepárese el botón de plomo. Límpiese el botón de plomo por medio de unos cuantos martillazos al ser posible; colóquese en un vaso de análisis de 150 c. c. y disuélvase el plomo con ácido nítrico diluido, (1 volumen de ácido nítrico por 3 de agua). Colóquese en baño María para ayudar a la solución. Cuando se haya disuelto todo el plomo fíltrese en un filtro sin cenizas y lávese el residuo de osmiridio en el filtro hasta quedar libre de plomo. Séquese el filtro, sepárese el osmiridio de él tanto como sea posible y quémese el papel-filtro. Agréguese el osmiridio al residuo del papel, séquese completamente en la plancha y pésese como osmiridio.

La escorificación con plomo es con el objeto de limpiar el osmiridio de la arena, de los óxidos gruesos, etc., etc. El osmiridio es recogido por el plomo y las impurezas son excluidas. Se necesita algún cuidado para la ignición del residuo, porque el osmiridio perderá osmio si se calienta al rojo al aire. Por esta razón el papel es quemado después de la separación del osmiridio.

Determinación del platino.

Llénese el frasco de 1,000 c. c. conteniendo la solución del mineral hasta la marca. Mézclese echándola en un vaso de análisis seco y viceversa tres o cuatro veces. Tomando una probeta de 25 c. c. que haya sido cuidadosamente estandarizada, métase en el frasco de 1,000 c. c. y sáquense dos porciones a los vasos de análisis de 75 c. c. Evapórense esas porciones hasta secarlas en baño María. Agréguese a cada una 5 c. c. de ácido hidroclórico diluido, (1 parte de ácido a 9 de agua, y caliéntense durante cinco o diez minutos. Déjese enfriar y a menos que no esté perfectamente clara fíltrese en papeles-filtro de 5½ cents. en vasos de análisis similares. Lávese con agua hasta que los filtros de papel queden completamente incoloros. Esta operación puede ser hecha fácilmente con menos de 20 c. c. de agua.

Hágase cada porción de manera que contenga como 25 c. c. Agréguese a cada una 0 gm. de c. p. cloruro de amonio y caliéntese en baño María durante una hora agitándolo de cuando en cuando. Quítese del baño y déjese reposar cuando menos durante tres horas o si fuere pasible durante una noche si así conviniera. Decántese la solución clara a través de un filtro sin cenizas de 9 cents. en un vaso de análisis de 150 c. c. Déjese que pase toda la solución através y enseguida lávense los precipitados de cloro-platinato de amonio, $(NH_4)_2PtCl_6$ dentro de los filtros con 20 por ciento de solución de cloruro de amonio. Déjese que pase la solución através y luego lávese repetidas veces al derredor de los bordes del papel con pequeñas cantidades de la solución de cloruro de amonio al 20 por ciento, hasta que el filtrado quede incoloro y el papel quede blanco. Finalmente lávense los bordes con alcohol. Después de que toda la solución haya pasado colóquense los filtros con sus puntas hacia abajo en unas tazas Battersea tamaño B. Cuidadosamente dóblense los bordes de los papeles, de manera de incluir todos el precipitado en un sobre de papel. Cúbranse los crisoles y sujétense a un buen calor rojo aumentando lentamente el calor. Finalmente, quítense las tapaderas a los crisoles hasta que se quemen los papeles. Después del enfriado pásese el platino al platillo de la balanza de ensaye y pésese. El duplicado no deberá de variar más de 2 mgm. El promedio se toma como el correcto.)

La precipitación del $(NH_4)_2PtCl_6$ se hace generalmente con la adición de alcohol para reducir la supuesta solubilidad del precipitado. Puede tenerse seguridad de que con el método arriba descrito pueden tomarse 0.0004 gm. de platino en la solución dada antes, 25 c. c. lo precipitan, lávese con la cantidad usual de solución y se consigue de nuevo más que la mitad del platino original. La solubilidad bajo las condiciones dadas puede desatenderse para este ensaye.

Las soluciones son calentadas en baño María por dos razones: primera, conseguir todo el cloruro de amonio rápidamente en solución y segundo, cambiar el precipitado de un estado amorfo a un arenoso y cristalino el que es fácilmente filtrado y lavado.

El precipitado de platino generalmente

contiene iridio como $(NH_4)_2PtCl_6$ es de un amarillo puro. El compuesto de iridio tiene un color rojo intenso. Si contuviera dos décimos por ciento de iridio éste daría un tinte rojizo al precipitado de platino. La cantidad de iridio contenido si no es mayor de 5 por ciento puede juzgarse por el color del precipitado con una exactitud suficiente para calcular el valor del mineral.

Se verifica una pequeña pérdida en la ignición del precipitado de platino. La pérdida se minora teniendo incluida en el papel del filtro y por medio del calentamiento lento.

Determinación del oro.

Combínese el filtrado de la precipitación del platino y agréguense 5 gramos de sulfato ferroso en solución con agua más HCl. Déjese reposar hasta que se asiente el oro. Fíltrese y lávese en el filtro, cámbiese a una taza da templar y quémese el papel frente a la mufla. Cuando se enfríe envuélvase en laminilla de plomo y copélese de la manera usual del oro.

Agréguese al filtrado del oro como una quinta parte de su volumen de ácido hidroclórico. Agréguese un 10 por ciento de solución de yoduro de potasio, cinco gotas, hasta que no se verifique más precipitación de yoduro negro de paladio (PdI_2). Caliéntese en la placa casi hasta que hierva. Enfríese, fíltrese y lávese con ácido hidroclórico diluido (1 parte ácido por 4 de agua). Lávese y cámbiese a un crisol de porcelana y quémese en la mufla hasta llegar a un buen rojo. Enfríese y humedézcase con unas cuantas gotas de ácido fórmico diluido hasta reducir el óxido y séquese en la placa. Llévese al platillo de la balanza y pésese el paladio.

Las obras de texto generalmente se refieren al yoduro de paladio en el sentido de ser de fácil solubilidad en Kl. Esto es verdad; pero la presencia de una gran cantidad de HCl probablemente evita cualquier exceso de Kl formándose ácido hidroclórico y cloruro de potasio. Esta precipitación es completa. La solución fuerte de ácido hidroclórico también evita la precipitación de los yoduros de cobre y plomo si sólo se usa un pequeño exceso de Kl.

El ácido fórmico diluido reduce los óxidos de paladio a metal.

Determinación del rodio.

Al filtrado del PdI_2 agréguese c. p. zinc hasta que la solución quede incolora calentando la solución mientras esa operación se haga. Déjese que se disuelva todo el zinc y que se asiente el precipitado. Decántese la solución y lávese el precipitado tres veces por decantación con porciones de 100 c. c. de agua caliente. Agréguense 25 c. c. de ácido nítrico diluido (1 parte de ácido por 3 de agua), y colóquese encima del bano María por 10 minutos. Fíltrese en un filtro sin ceniza, lávese dos o tres veces con agua, quémese, reduzcase en hidrógeno y pésese como rodio, más vestigios de iridio.

El zinc reduce todos los metales de platino de la solución. En este caso sólo el rodio y los vestigios del platino están presentes. El ácido nítrico disuelve cualquier metal básico que pudiera estar presente, pero como el rodio recientemente precipitado se disuelve con lentitud en el ácido nítrico el tratamiento no deberá de prolongarse mucho.

Un ensayo representativo del metal crudo sería el siguiente: Osmiridio, 20 de fino; Pt (conteniendo 3 por ciento de Ir,) 830; Pd, 5; Au, 30; Rh, 20 fino.

Las soluciones fuertemente coloreadas proporcionadas por todos los metales de platino dando la menor menor cantidad de colorante el platino forman una buena guía para la terminación del lavado, preparación del zinc, etc.

Los Terrenos Petrolíferos en México

He leído en el Boletín de Mayo de 1914 un artículo escrito por H. von Hofer, relativo al orígen del petróleo, en el cual el autor apoya su opinión y la de Engler expresada antes, con relación al origen orgánico del petróleo. Von Hofer habla muey fuerte en contra de la hipótesis del origen volcánico de los hidrocarbones defendida por Eugene Coste.

En el artículo del Sr. Coste, ya muy conocido por el público, se refiere incidentalmente a la manera como se encuentra el petróleo en México con especialidad en la zona del Golfo de México, como prueba del origen volcánico de los aceites. Esta creencia proviene del hecho de que en la generalidad de los terrenos petrolíferos de la costa Este, la mayoría de los pozos productores están situados cerca de crestones volcánicos, (restos de pequeños volcanes, principalmente del tipo explosivo), o próximos a ciertas gibosidades en esquistos en forma de montículos, algunos de los cuales son en realidad debidos a fuerzas volcánicas o a erupciones abortivas.

El primer intento que se hizo en México para explicar la presencia del aceite cerca de los crestones volcánicos fué hecho por mí, en un pequeño artículo publicado en 1905 en las Memorias de la Sociedad Alzate, en el vol. XXII, inmediatamente después de la investigación que se ordenó se hiciera por orden del Gobierno Mexicano, para averiguar sobre las probabilidades como futuro productor de aceite que existían en las costas del Golfo de México.

Cuando el Sr. E. L. Doheny de Los Angenes, Cal., y yo localizamos el primer pozo productor de México, yo fuí también el primero en predecir el brillante porvenir de la industria petrolífera de México, justamente al mismo tiempo que algunos geólogos mexicanos emitían sus opiniones pesimistas sobre el mismo asunto. Los hombres de negocios de México y el público en general, como resultado de esos informes no prestaron atención a esta importante fuente de riqueza hasta estos úúltimos días, y la confirmación de la existencia de tales riquezas, ha sido tan repentina que no son infundados los temores de estar amenazados por las consecuencias que siempre acarrea un gran boom.

Era casi imposible hace cinco años convencer a los capitalistas mexicanos para que invirtieran dinero en negocios petrolíferos, por cuya razón las grandes compañías muy pocas en número, que existían trabajando desde aquella época no les fué difícil asegurar grandes extensiones de terreno aún a despecho de las irregularidades de los títulos de propiedad de los supuestos propietarios de los citados terrenos.

El objeto principal de este pequeño trabajo es el de dilucidar el hecho de que la relación que existe entre el aceite y los pequeños aparatos volcánicos es exclusivamente mecánico, no teniendo nada que ver, por supuesto, con el origen del aceite el cual es hipotéticamente considerado por nosotros como una derivación puramente orgánica. Nuestro petróleo no es nativo de las rocas en las cuales existen las cavidades o poros en donde se encuentra acumulado.

Como es bien sabido, los terrenos petrolíferos mexicanos están constituidos por una formación esquistosa gruesa intercalada en lugares, especialmente cerca de las grietas del aceite, con una variedad de una pizarra arenosa y unas capas delgadas pedernalinas del mismo material. Esos cuatro mil o cinco mil pies de esquistos probablemente proceden de una gruesa formación cretacea de piedra caliza con otras rocas sedimentarias intercaladas, en las cuales probablemente el aceite tiene su origen.

No obstante lo que dice el Sr. Von Hofer en el artículo a que me refiero, al comentar las opiniones de un geólogo mexicano, de que el terreno petrolífero es uno que ha sufrido perturbaciones, yo soy de contraria opinión. Esa sección de la costa Este de México no muerta signos de grandes perturbaciones. La formación esquistosa, según se puede ver en los tajos hechos por los ríos, muesta únicamente ligeras ondulaciones graduales, arrugas bajas monoclinales y amplias oquedades pero nunca grandes o repetidos pliegues ni grandes fallas. Estas últimas, según pude observar, son generalmente de muy poca importancia.

Los diques son casi desconocidos en los terrenos petrolíferos centrales entre los ríos Támesis y Túxpam y aparte de ligeras abruptuosidades y pequeñas corrientes de lava, son muy raras en los cerros de rocas plutónicas como dioritas y sienitas nefelinas. Más al Norte en el Estado de Tamaulipas y hacia el Sur de la parte central del Estado de Veracruz algunas sierras que quiebran los planos de la costa presentan estructuras geológicas más complejas.

Traducción de un artículo escrito por el Sr. Ezequiel Ordóñez en "Transactiens of The American Institute of Mining Engineers."

Las areas interiores locales muy alteradas ciertamente existen, pero hasta la fecha no se ha probado su productibilidad. También se encuentran esquistos muy alterados como una faja en la margen Oeste de la formación frente a las calizas que sirven de bases a las montañas de la Sierra Madre.

Las prominencias volcánicas son vistas en las planicies de la costa desparramadas en forma de conos aislados o bien en pequeños grupos de montañas, el primer tipo está maravillosamente representado en la sección situada entre Chicontepec y Tuxpan del Estado de Veracruz.

No haríamos responsable a la acción volcánica de todas las ondulaciones o ligeras protuberancias de estructura giboza de las grandes formaciones esquistosas que contienen el petróleo, pues todo tiende a probar que la estructura principal, débil como es ella, es posterior a la actividad volcánica de la costa. El tapón o chimenea volcánica de cenizas y de lava basáltica compacta del cual el crestón es el extremo superior, no ha producido alteraciones de consideración en la pizarra a su derredor, y yo supongo que su natraje a través de la roca sedimentaria debe haber sido como la de un tornillo a través de una pieza de madera. Yo me imagino que durante la erección de esas chimeneas o tapones y la salida por ellas de las masas recónditas de material ígneo, se verificó cierta absorción de los sedimentarios por el material fundido en las profundidades, también tuvo lugar la quebradura de los sedimentarios cerca de la intrusión y, finalmente una aureola angosta al derredor del tapón de material quebradizo ocasionada por la fricción, cuya zona es utilizada en muchos casos para la elevación de pequeñas cantidades de petróleo a la superficie y la formación de escapes de muy lenta acumulación.

Un número de grandes escapes cerca el cual se han hecho importantes descubrimientos se encuentran al pie de los crestones entre la pizarra y la roca basáltica; otros escapes descansan en el flanco de algunos montículos de forma cónica. En casos no muy raros se encuentran panes duros de chapopote con un aceite suave que les escurre, cuyos encuentros suelen verificarse en el fondo de pequeños anfiteatros o espacios circulares en forma de herradura, y en general, en las concavidades hechas por las líneas de curvas de montañas y pequeños cerros. Estos distintos casos de escapes son muy favorables para la localización de pozos, según está probado por experiencia en el Cerro de la Paz, Chijol, Juan Casiano, Cerro Azul y otros. Muchos de esos pequeños escapes o chapopoteras se encuentran en la parte central de las planicies de la costa, lejos de cualquier prominencia o accidente topográfico. Frecuentemente se observa que el aceite o petróleo expelido no proviene del fondo del lugar en donde se le encuentra en la superficie, sino que suele seguir trayectorias diagonales, muchas veces de considerable distancia en la pizarra entre esta y las gruesas capas de metal arcilloso que cubren la roca.

En el estado actual de nuestros conocimientos geológicos de los terrenos petrolíferos, es difícil explicar algunas areas productoras cerca de los bancos de los ríos, las cuales no tienen aparentemente conexión con los reventones volcánicos ni con los montículos. Desgraciadamente los detalles y observaciones hechas durante la perforación por los expertos de los pozos, en este sentido y otros de particular interés, nunca llegan al dominio público.

Yo he presenciado muchos casos de pequeñísimas exudaciones que salen muy lentamente de angostas quebraduras o grietas y pequeñas fallas en los bancos escarpados de los ríos en donde las pizarras han sido cortadas por el desgaste. Este es el caso en muchos lugares en los ríos Tecclutla, Tuxpam, Calabozo, Pánuco, Tamesí, Valles, etc., etc.

Las vetas sin importancia de albertita y grahamita tan conocidas en la costa, probablemente proceden de antiguas exudaciones que llenaban grietas o quebraduras en donde el chapopote se seca lentamente, se oxida un poco y luego ha sido sujeto a presión.

Aceite más ligero que el comunmente encontrado en la costa, parece que se ha encontrado a pequeñas profundidades en las pizarras alteradas cerca de las piedras calizas, al pie de los cerros de la Sierra Madre. Esto parece coincidir, como en Aquismon, con la impregnación local de la piedra caliza con productos del aceite ligero. En este caso el petróleo probablemente sube a través del contacto entre el esquisto y la piedra caliza.

No obstante de que en la faja superior de los terrenos petrolíferos las particularidades de ellos permanecen aún enteramente desconocidos, en la opinión del que esto escribe, parece que no es difícil la existencia de petróleo en esta larga faja, bajo condiciones probablemente distintas a las de las extensiones ya conocidas, o en la vía de desarrollo cercanas al Golfo de México o bien en los esteros que los circundan.

Yo he estudiado cuidadosamente con el microscopio las arenitas o polvos de los sedimentos que contienen los aceites procedentes de varios pozos, con especialidad de aquellos cercanos a Tampico. Este sedimento está compuesto de astillas minúsculas de esquisto y de granos redondeados de material basáltico similar a las rocas de los crestones. El origen volcánico de ciertos montículos y la influencia de la acción volcánica como favorecedora de la acumulación del petróleo está demostrada por lo que hemos visto de partículas de roca que trae el aceite de los pozos en donde no existen crestones o cualquier otro vestigio de roca volcánica en las proximidades.

Si como suponemos la formación esquistosa no está muy perturbada y no existe allí en realidad una estrata porosa continua en formación, tendremos que creer, en virtud de nuestros escasos conocimientos adquiridos hasta hoy, en la materia, que las vetas porosas impregnadas posteriormente con petróleo a las profundidades comunes de 2,500 a 2,700 pies a cuya profundidad se encuentra por lo general el petróleo, son hechas o producidas por la acción volcánica. Las masas de estrata corroída por la lava fundida se extienden a esta profundidad. Es evidente que la estrata que se convierte en porosa deberá mostrar una estructura física especial y alguna composición química particular distinta al resto de las bases, la cual facilita tanto la corrosión parcial por la lava caliente. Nosotros nos imaginamos los hilos o vetas de petróleo extendidos horizontalmente en forma de vigas de grandes dimensiones. Con objeto de demostrar las capacidades vamos a calcular un grupo de vetas capaces de producir 3.000,000 de barriles sin interrupción como el primer pozo productor de petróleo de México situado en el cerro de la Paz cerca de Ebano o el famoso que se quemó de Dos Bocas.

Las peculiaridades de la estrata como se supone existe, no obstante que es de una naturaleza enteramente desconocida, debe de existir, desde el momento que está dentro nuestra estrata conteniendo aceite en forma parecida a un horizonte de aceite a una profundidad media de 2,600 pies.

El agotamiento de un buen pozo productor está marcado con la presencia de agua salada en abundancia, lodo y ácido sulfúrico en solución. Los espacios porosos después de haber dado el petróleo son probablemente llenos de nuevo parcialmente con agua salada que viene de las vetas procedente de los antiguos conductos más profundos. La ascensión del petróleo a través de los agujeros hechos por las perforaciones es originada por la gran presión del gas; el rendimiento de los pozos es generalmente intermitente. Existen sin embargo derrames de larga vida, contándose entre otros el citado pozo del Cerro de la Paz que ha producido como 1,500 barriles diarios por un espacio de cerca de 70 meses.

Dificultades especiales para la rápida y eficaz perforación no se ha tropezado con ellas en la parte Norte de Tamaulipas y el Sur de Veracruz lo mismo que en la costa Este de Oaxaca y Tabasco, pues las condiciones geológicas de las pizarras están disimuladas por gruesas capas de arena de río y cascajo marítimo y lodo en el Norte y en el Sur cubriendo la vasta extensión que se extiende en el territorio istmíco. La situación particular del Istmo con relación al resto de la costa Este de México y de la Península de Yucatán ha creado condiciones climatéricas peculiares que facilitan nuevas masas de detritus favorecidas por las abundantes lluvias, vientos, calores y avenidas de los ríos.

Tratamiento para los Axfixiados en las Minas

El comité que fué nombrado para que estudiase el modo de resucitar a los que

se asfixian en las minas, por el Consejo de Sanidad e Instrucción Pública de la Asociación Médico-Americana, a petición de la Oficina de Minas del Departamento del Interior, acaba de publicar sus trabajos. Este comité lo componían los doctores Walter B. Canon, presidente, profesor de fisiología en la Universidad de Harvard; George W. Crile, de Cleveland, Joseph Erlanger, profesor de fisiología en la Universidad de Washington, St. Louis; Yandell Henderson, profesor de fisiología en la Universidad de Yale, y S. J. Meltzer del Instituto Rockfeller.

El director de la Oficina de Minas pidió a este comité que hiciera sus investigaciones con el fin de desarrollar algún método sobre la resurrección y que pudiera ser aplicado por los mineros u otras personas que no hayan recibido instrucción médica, pero a quienes con frecuencia se les presenta la oportunidad o tienen ocasión de ir en auxilio de sus compañeros asfixiados con los gases de las minas y en donde muchísimas veces la tardanza del médico o del cirujano pone en peligro la vida de la persona.

Este comité dice que ha visitado las minas de carbón bituminoso y antracita situadas en el Estado de Pennsylvania, ha conocido y hablado con personas de gran experiencia en el asunto, presenciado demostraciones de respiración artificial según varios métodos, haciendo de ellos un minucioso examen, y estudiado todos los aparatos mecánicos inventados para mantener la respiración, y llevado a efecto grandes experimentos con el objeto de descubrir el mejor medio de resucitar al individuo después de haber aspirado el grisú u otros gases mefíticos.

En su informe hacen consideraciones sobre la fisiología y patología del envenenamiento con el monóxido de carbono; discute los métodos Sylvester y Schffer de la respiración artificial, y siguiendo la misma vía trazada en su anterior informe sobre la resurrección de las víctimas de descargas eléctricas, recomienda favorablemente el método Schaffer por ser su aplicación más sencilla y fácil, puesto que se evita la molestia de que la lengua obstruya el paso del aire, reduce el peligro de dañar el hígado o fracturar las costillas, y porque permite a los pulmones mayor ventilación.

De acuerdo con lo que ha dicho el comité, sobre las primeras ventajas no hubo ninguna duda. Con respecto a la cuarta, o sea mayor ventilación, el comité inició una serie de experimentos con hombres y animales, con el resultado de que han considerado el método Schffer como el más eficaz para la respiración artificial.

Respecto a aparatos mecánicos el mercado ofrece cuatro máquinas: el pulmotor de Draeger; el aparato del Dr. Brat; el motor para pulmones; y el Salvator. El pulmotor y el aparato del Dr. Brat fueron sometidos a ensayos por el mité, pero los han desaprobado porque dicen que la repetida succión del aire de los pulmones no es fisiológica, y, si se continuase, vendría a ser perjudicial y causaría en ellos la inflamación. En relación con los experimentos llevados a efecto por el comité con aparatos mecánicos, el Dr. Meltzer ha inventado uno que es de fácil aplicación y éste lo recomiendan debido a ciertas ventajas: falta de succión al respirar, poco peso, baratura y sencillez. La descripción de tal aparato y manera de construirlo las contiene el folleto publicado por el comité.

Resumiendo sus experiencias y descubrimientos, el comité recomienda la respiración artificial en todos los casos de envenenamiento con gas, y, cuando no se tiene a mano ningún aparato mecánico, aconseja el método manual como primera ayuda. De estos métodos recomienda aquél de presión con el individuo tendido en el suelo, a menos que el paciente tenga alguna lesión que lo impida, y si tal es el caso, deberá emplearse el método Sylvester. En los envenenamientos con monóxido de carbono deberá darse oxígeno en vez de aire. Si el paciente se halla aún respirando espontáneamente, se le dará el oxígeno colocándole en la cara una máscara provista de válvulas de salida y entrada y éstas conectadas a un saco que reciba el oxígeno del cilindro. El aparato Meltzer lo recomiendan como el mejor de los que se conocen.

"Este informe y el otro sobre la resurrección de descargas eléctricas son notables y valiosas contribuciones a nuestro conocimiento práctico y científico de las causas, condiciones y tratamientos de los accidentes industriales," dice The **Journal of the American Medical Association.** "La publicación The Electrical World, después que apareció publicado el informe que trataba sobre la resurrección de las víctimas de descargas eléctricas, reprodujo un gran número de estos informes y, junto con un mapa, los distribuyó en todas las instalaciones eléctricas, casas de máquinas generatrices de fuerza motriz y estaciones de los Estados Unidos de América. Estos informes han sido traducidos a varios idiomas juzgándolos como informes fidedignos sobre el asunto. El informe que se refiere a la resurrección de las personas que se han envenenado con gases de minas es también de mucho valor y digno de que tenga la misma extensa circulación.

Depósitos Minerales de la Parte Norte Central de la Baja California

En la región explorada existen criaderos de oro, cobre, fierro, manganeso y de otros minerales, tales como mica, turmalina, granate, topacio, zafiro y turquesa, que pueden tener variadas aplicaciones industriales, o pueden ser aprovechados en joyería como piedras más o menos finas.

De todos los criaderos minerales citados, los más importantes son los criaderos de oro, que clasificaremos en dos tipos principales: criaderos de oro en "vetas" y criaderos de oro de "placer." Tuvimos oportunidad, en nuestra exploración, de visitar los yacimientos de San José, El Socorro y Los Enjambres, pertenecientes al primer tipo, y a los de Campo Juárez, Los Pinos y Campo Nacional, pertenecientes al segundo.

Los yacimientos de San José y El Socorro se encuentran situados al E. de la sierra de San Pedro Mártir; el primero casi al pie de la sierra, a una altura de 680 m. sobre el nivel del mar, y el segundo más arriba, a 1,300 m.; el criadero de Los Enjambres se encuentra situado al S.W. de la misma sierra, a 87 m. de elevación, en la barranca de ese nombre y a un lado del camino que va al rancho El Portezuelo. Las vetas de San José y El Socorro son vetas de cuarzo aurífero, cuyo espesor varía entre 5 y 50 centímetros, y cuya dirección general es, en San José, de 20° N. E., con echado de 60° al S. E., y en El Socorro, de 45° N.W., con inclinación de 80° al S.W.; en Los Enjambres las vetas no se definen bien, su dirección es muy irregular y en ellas se encuentra el oro, de preferencia en las partes más oxidadas del criadero, en tierras ferruginosas, que llaman en la localidad "tierras podridas."

Algunas de las vetas de los criaderos auríferos de la región arman en granitos; pero la mayoría de ellas se ven atravesando a las pizarras metamórficas, y es importante observar que las vetas más productivas de estos criaderos han sido, casi siempre, las vetas que se encuentran contenidas en las pizarras metamórficas.

Como yacimientos "secundarios," es decir, como yacimientos se han formado por el acarreo y depósito de los materiales mineralizados que provienen de los yacimientos primarios que acabamos de citar, debemos considerar a los aluviones auríferos que constituyen los yacimientos de los campos minerales de Juárez, Los Pinos y Campo Nacional. Los campos de Juárez y Los Pinos se encuentran situados en la sierra de Jua-

[*] Parergones del Instituto Geológico de México.

rez, y cubren una superficie total, aproximadamente, de 20 kilómetros cuadrados, siendo el espesor de sus depósitos aluviales auríferos muy variable; en algunos lugares alcanzan un grueso inferior a un metro, y en otros llega a ser hasta diez metros, como se ve en ciertas excavaciones de trabajos antiguos. W. Lindgren, que visitó el yacimiento de Campo Nacional el año de 1888, estima en 50 pies (1) el espesor de los depósitos auríferos de aquel campo minero, y afirma que éstos deben su origen al acarreo de un antiguo e importante río, cuya dirección precisa no le fué posible determinar; pero que es probable que haya tenido un curso general de E. a W., y dice, además, que en cuanto a la edad de estos aluviones, nada definitivo se puede asegurar, y sí sólo que se formaron cuando la hidrografía y topografía de la península eran muy distintas a las actuales; pero que pueden ser de edad Terciaria y equivalentes a los aluviones auríferos de la Sierra Nevada.

En la época de nuestra visita, todos estos campos estaban con sus trabajos paralizados, y únicamente en el de Los Pinos se hacían preparativos para comenzar de nuevo su explotación, y no pudimos, por consiguiente, obtener ningunos datos precisos acerca de la historia y producción de estos campos mineros; solamente supimos, por informes de particulares, que el campo Juárez es el más antiguo, y probablemente el más importante de todos, y que el de El Socorro hace cerca de 20 años que se descubrió, y que produjo en los últimos tres años de su explotación más de $100,000. En los campos de Juárez y Los Pinos se ha explotado el oro por medio de dragas, cuyos resultados no pudimos apreciar, por la circunstancia ya citada de que estos campos no estaban en explotación en la época de nuestra visita.

Los criaderos de cobre de la región explorada se encuentran situados en los alrededores de la antigua misión de San Fernando y Sausalito, y se presentan como vetas que arman en la diorita o como criaderos de contacto entre la diorita y el granito. En los alrededores de San Fernando las vetas tienen una dirección general de N. a S., con inclinación de 40° al W., y su potencia llega a ser hasta de 1.20 m. en los crestones; y en El Sausalito se presentan ros son principalmente malaquita, azurita, con sulfuros de fierro y cobre y sus leyes, según informes que nos dió un minero de la localidad, han variado desde 7 hasta 35 por ciento. Ninguna de las minas abiertas en estos criaderos, que tuvimos oportunidad de visitar, se encontraba en explotación, y todas estaban inundadas y casi abandonadas.

(1) Notes in the Geology of Baja California, Mexico, by W. Lindgren, U. S. Geol. Survey. Proceedings of the California Academy of Sciences. 2d. series, I, San Francisco, 1889, pág. 193.

Los criaderos de fierro se encuentran algunas veces asociados también a los de manganeso. En la sierra de Juárez hay algunas vetas de manganeso; pero tanto los criaderos de manganeso como los de fierro, de las sierras, no son de importancia industrial.

En las pegmatitas de San Pedro Mártir se encuentran, con frecuencia, criaderos de mica que pueden ser de alguna importancia, por las variadas aplicaciones que tiene actualmente la mica en la industria. La mica se presenta en "florones" que llegan a alcanzar hasta 15 centímetros de longitud por 6 de anchura, o en láminas exagonales de dimensiones menores.

En estas mismas pegmatitas se encuentran en abundancia cristales de turmalina común, que llegan a tener un tamaño notable y que podrían utilizarse para ciertos instrumentos de óptica. Aunque nosotros no encontramos, a pesar de haberla buscado con esmero, a la variedad rosada de turmalina (rubellita) que en San Diego, California, viene en lepidolita, es posible que se encuentre esta variedad en pegmatitas de la región, dada la abundancia con que se presenta la turmalina en algunas de las citadas pegmatitas.

En los alrededores de Jacumba tuvimos oportunidad de colectar numerosos ejemplares de granates y topacios, que por su lustre, color, dureza, etc., se pueden aprovechar como piedras finas en joyería; estos granates y topacios son conocidos en la localidad con el nombre de "jacintos," y se encuentran también en las cercanías de Jassay. En los alrededores de Jacumba se ha señalado (1) la existencia del berylo, asociado a la essonita, y en Ensenada nos fueron mostrados dos ejemplares de zafiro que nos dijeron procedían del lugar llamado Tanamá, en las cercanías de Tecate; pero en nuestra excursión no encontramos ni berylos, ni zafiros de las localidades referidas.

En la proporción meridional de la región explorada a un lado del camino que va de la antigua misión de San Fernando a Sausalito, en el paraje llamado El Barril y en la vecindad del rancho de La Peña, en el camino de aquella misión a Rosarito, existen criaderos de turquesa en la zona de contacto de las dioritas con rocas eruptivas. La turquesa procedente de estos criaderos es de un color verde azulado; pero la hay también en menor cantidad, de un hermoso color azul que la hace muy propia para ser empleada en joyería, como piedra preciosa. En nuestras colecciones figuran turquesas cuya localidad es el Mineral de El Aguajito, situado a 40 kilómetros al E. de Rosario, sobre el camino que une a este lugar con San Fernando. Algunos de estos criaderos parecen completamente agotados, y es probable que exploraciones detenidas, en esta zona, descubran nuevos criaderos.

(1) California State Mining Bureau. Bulletin No. 3, pág. 152.

Hemos dicho ya, al tratar de geología de la región, que los granitos de las sierras de Juárez y San Pedro Mártir presentan una gran variedad de texturas y colores, y esto hace que se presten mucho para ser utilizados como materiales de construcción. Entre las localidades que merecen citarse, en primer lugar, por la hermosura de sus granitos, están las siguientes: cerro de La Corona, cerros de los alrededores del vallecito de La Tasajera, granitos de la vereda entre El Socorro y La Grulla y granitos del Cañón de Santa Rosa, en la sierra de San Pedro Mártir. Los granitos de La Corona son granitos de grandes elementos, en los cuales domina la hornblenda; los de los alrededores del vallecito de La Tasajera presentan un feldespato de color rosado, que les da un tinte bastante agradable, y los que se encuentran entre El Socorro y La Grulla, son granitos gneíssicos, en los cuales se ve también el feldespato rosado, pero de color más pálido. En el Cañón de Santa Rosa existe un granito muy hermoso; este granito es de grandes elementos, y en su masa contrastan notablemente la mica de un color negro intenso, con el blanco del feldespato y con los cristales brillantes y transparentes del cuarzo; es frecuente encontrar diseminado en esta roca un granate rojo (llamado equivocadamente "rubí," en la localidad) que contribuye a aumentar su belleza. El granito de esta clase es bastante abundante en el cañón de Santa Rosa, y se podría explotar económicamente, por el lado del Desierto, ligando al mencionado cañón con el camino que va a San Felipe, lo que puede hacerse fácilmente.

En el límite S. de la región recorrida se encuentran los criaderos de tecali (material de construcción y ornamentación llamado "mexican onyx" en los Estados Unidos del Norte), que explota la New Pedrara Co. La explotación de estos criaderos, con un trabajo diario de 25 operarios, produce en la actualidad de 60 a 80 toneladas mensualmente, que son vendidas a razón de 10 dollars el pie cúbico, por término medio, en diferentes mercados americanos. Están situados estos criaderos en una planicie cuya altura sobre el nivel del mar es de 730 m., y que se encuentra rodeada por un lomerío y algunas mesas y cerros de poca elevación. El tecali se presenta en bancos horizontales o poco inclinados, hasta de 1.60 m. de espesor, que descansan sobre un conglomerado reciente y que se ven alternando, en algunos lugares, con capas de toba caliza y travertino. El tamaño de los blocks que se extraen de estos bancos varía mucho.

Fuimos informados por el señor Cyril Golden, encargado de los trabajos en esa época, que el block más grande que se ha extraído de estos criaderos fué exportado a Nueva York, y tenía 3 m. de largo por 1.20 m. de ancho y 0.75 m. de espesor. Este mismo señor nos proporcionó los datos siguientes, relativos a

explotación, costo de extracción, transporte, etc.: los criaderos de tecali de la New Pedrara Co. se han explotado, con cierta actividad, desde hace unos ocho años, con operarios yaquis, en su mayor parte, que ganan de $2.50 a $3.00 diarios; actualmente se trabajan cuatro secciones, distribuidas en una superficie aproximada de un kilómetro cuadrado, correspondiendo cada una de estas secciones a diferentes depósitos de tecali, en las cuales domina el tecali blanco, veteado de amarillo pálido o café, siendo el verde o rosado menos frecuente, y, puede decirse, relativamente escaso. El costo de la extracción, por pié cúbico, es en promedio de $1.35 mex.; el transporte al puerto de Santa Catarina, situado a unos 88 kilómetros de distancia, se hace en carros, que pueden cargar hasta 10 toneladas, y cuesta de $20.00 a $25.00 mex. por tonelada.

La visita a estos criaderos, que fueron estudiados por S. F. Emmons y G. P. Merrill en 1892 (1), era para uno de nosotros de un interés especial, por haber tenido oportunidad en otra excursión de estudiar la génesis de criaderos de esta naturaleza en otra localidad mexicana. (2). Emmons y Merrill consideran a estos criaderos como depósitos formados por manantiales termales, y respecto a su génesis dicen lo siguiente: "The ocurrence of the onyx, which is a thermal spring and surface deposit in succesive layers, separated by travertine and resting on conglomerate, indicates a probable succesive rise and fall of the waters of the lake where the travertine was deposited, which would have admitted of some sligh erosion of the deposit in the periods when the lake waters had temporarirly retreated, a hypothesis that was confirmed by the finding of some fragments of onyx in the upper travertine beds.—At the head of the ravine the travertine beds end abruptly in an escarpment beyond which one descends rapidly 500 feet through winding ravines, between sharp, jagged ridges of a metamorphic rock to the bed of the Tule arroyo, a winding V—shapped gorge which runs northward about ten miles, then northeastward to the Gulf of California draining the whole region east of the divide. At one point of this gorge widens out into quite a valley, in which are travertine deposits about 50 feet thickness with layers of onyx in the upper part. Relics of the thermal action are found at the present day in a little effervescent spring, known as the volcan, which issues from the top of a dome—shaped mound of calcareous tufa in the narrow bottom of the ravine before it opens out into the valley containing the travertine deposits."

Es indudable que la génesis de estos yacimientos está estrechamente ligada con el depósito de las tobas calizas y travertinos de la región, de los cuales el tecali no es propiamente, sino una variedad, debida solamente a modificaciones de estructura, mayor pureza relativa de composición y fenómenos de coloración originados por la presencia de óxidos y carbonatos metálicos; pero nos parece que la formación de algunos de estos depósitos podría explicarse también por la acción disolvente a la temperatura ordinaria de las aguas cargadas de ácido carbónico que circulan a través de las calizas de la región, es decir, de la manera siguiente, que ya hemos expuesto en otra ocasión: (1) el agua cargada de ácido carbónico tiene la propiedad de disolver a la temperatura ordinaria el carbonato de cal, haciéndolo pasar al estado de bicarbonato; disuelve también más lentamente a los silicatos de cal, potasa y sosa, y a los óxidos de fierro y manganeso que se presentan, con frecuencia. Ahora bien, el agua meteórica contiene en disolución, como es bien sabido, cierta cantidad de ácido carbónico de la atmósfera, cantidad que con el paso del agua por el suelo, aumenta en proporción notable, sobre todo en presencia de materia orgánica; el agua meteórica, cargada así de ácido carbónico, ha circulado y circula actualmente a través de las calizas de la región, ejerciendo sobre ellas una acción disolvente bastante enérgica y concentra lenta, pero constantemente, el cloruro de sodio que contienen estas calizas de origen marino, en pequeña proporción; el agua, después de un curso subterráneo más o menos largo, aparece en diversos puntos del terreno formando los manantiales de agua salada a que hemos hecho referencia, y entonces se desprende por diminución de presión gran parte del ácido carbónico en exceso, y tiene lugar, por consiguiente, una precipitación de carbonato de cal, que según las condiciones del depósito y mayor o menor pureza relativa de composición, forma un yacimiento de tecali o un depósito de travertino o toba caliza.

La precipitación del carbonato de cal se efectúa de esta manera en los manantiales del arroyo de Los Volcanes, y la composición química de estas aguas, que hemos dado en páginas anteriores, parece comprobar la anterior explicación.

Como hemos dicho antes, los colores dominantes del tecali que se explota en estos criaderos son el blanco veteado de amarillo o de cafe, y esto hace que este material, aunque bastante bonito, no sea tan hermoso como el que hemos tenido oportunidad de estudiar procedente de los Estados de Oaxaca y Puebla; sin embargo, en los Estados Unidos es bastante apreciado, y pudimos verlo frecuentemente usado en los mostradores, fachadas, etc., de diversos establecimientos comerciales y edificios de San Diego, Los Angeles y otras localidades americanas.

(1) Geological sketch of Lower California, by S. F. Emmons and G. P. Merril.—Bulletin of the Geological Society of America. Rochester, 1894, Vol. V, pág. 509.

(2) Los yacimientos de tecali de los alrededores de Tequisistlán, Estado de Oaxaca, por T. Flores. Boletín de la Sociedad Geológica Mexicana. México. 1909, tomo VI, pág. 76.

(1) T. Flores, loc. cit., págs. 72 y 73.

El Estaño de Bolivia, S. A.

Por conducto del Sr. R. M. Atwater Jr., se ha sometido a la consideración del Gobierno de Bolivia una proposición para el establecimiento, en la costa del Atlántico, de una fundición de estaño, la cual utilizará los minerales de aquel país. Esa misma proposición ha sido puesta en manos del Secretario de Comercio de los Estados Unidos, Mr. William C. Refield, y se espera que, a su debido tiempo, tal asunto será abordado por los diplomáticos de ambos países. La accion oficial es necesaria en este caso porque, si tal proyecto llega a ser realidad, la Fundición pertenecerá al Gobierno de Bolivia y será administrada por una corporación americana bajo la supervigilancia de aquél.

Aunque las ganancias directas de la fundición irían a poder de los bolivianos, el provecho rendido por el manejo de la Planta, suministro de accesorios, etc., el cual se calcula en $500,00 anuales, más la comisión de venta, quedarían en los Estados Unidos. De mayor importancia aun sería el establecimiento del comercio con Bolivia que aquello supone y el cual excedería de $25.000,000 anuales.

He aquí algunos de los hechos que se han sometido al estudio del Departamento de Comercio: Bolivia produce el 25 por ciento del estaño que se expende en el mundo entero, pero no consume cantidad alguna de él; en cambio los Estados Unidos consumen el 40 por ciento de la producción mundial, pero no lo producen. El mineral boliviano no se funde en aquella República porque el alto precio de los combustibles no lo permite, sino que se envía a ciertos países europeos donde se efectúa el beneficio del metal. Malasia produce el 60 por ciento del estaño que consume; todos sus minerales son fundidos allí mismo, pero el metal se vende en los mercados de Londres. Los Estados Unidos, a pesar de ser los principales consumidores de estaño, se hallan colocados en las peores condiciones, puesto que, además de tener que someterse a los precios que fijan en Londres, necesitan pagar el flete marítimo desde allí hasta New York.

Al estallar la guerra, las entidades europeas que compraban los minerales bolivianos suspendieron sus operaciones suministrando así a los Estados Unidos, en concepto de los expertos, una magnífica oportunidad para independerse, al menos en parte, de los mercados europeos. Con el cese de tales exportaciones los dueños de minas se hallaron imposibilitados para continuar explotándolas y el Gobierno Boliviano dejó de percibir la considerable entrada que le producía el gravamen respectivo. Fué entonces cuando

el Sr. Atwater concibió la idea de que Bolivia podría construir una Planta en los Estados Unidos—el consumidor más cercano a ella—y donde el combustible es barato y la demanda es suficiente para colocar todas las cantidades producidas por dicho país.

La apertura del Canal de Panamá hace más halagadora aún tal propuesta. Según el plan respectivo, el Gobierno de Bolivia asegurará a los fundidores una cantidad adecuada y constante de mineral lo cual le será fácil obtener concediendo a los expertadores que envíen su producto a dicha Planta, el privilegio de la devolución parcial o total del gravamen pagado por ellos.

Desde hace mucho se considera la templadura del bronce como una de las famosas artes antiguas perdida para siempre. Sin embargo, por medio del tratamiento calorífico, se obtienen en la actualidad resultados muy satisfactorios. Los experimentos verificados por Guillet muestran que algunos bronces, especialmente los que contienen un 15 o un 20 por ciento de estaño, se hacen maleables cuando se les somete a ciertas altas temperaturas aunque, una vez fríos, son muy quebradizos. En las pruebas hechas con varias ligas de cobre las cuales contenían de un 5 a un 21 por ciento de estaño y las que fueron sometidas a temperaturas que variaban de 300 a 800 grados centígrados, se halló lo siguiente:

1. Las ligas que contienen más del 92 por ciento de cobre se hacen más resistentes cuando se las somete a una temperatura de 400 o 600 grados centígrados; su ductilidad aumenta a medida que la temperatura es más alta.

2. En las ligas que contienen menos del 92 por ciento de cobre, la resistencia y la ductilidad son más grandes aún si se las somete a temperaturas mayores de 500 grados centígrados. El máximum de tensilidad se obtuvo calentándolas hasta 600 grados centígrados. El máximum de extensión longitudinal depende de la composición de la liga. Con bronce que contenga 81 por ciento de cobre por 19 de estaño, se obtiene a los 800 grados; con el que contiene 79 de cobre y 21 de estaño, a los 600 grados. Puede establecerse como regla general que los bronces sometidos a temperaturas que varíen de 600 a 800 grados experimentan un aumento en su fuerza de tensilidad.

Análisis Térmico *

I.—Definición.

Por **análisis térmico** se entiende un nuevo método empleado en la investigación de las propiedades y constitución de los metales y sus aleaciones. Es distinto del químico, pues se basa únicamente en fenómenos producidos por el calor en los cuerpos.

Los cambios físicos y químicos que en en ellos se producen, van acompañados en general de una absorción, o despreadimiento del calor, aunque hay casos en que estos cambios ocurren sin que se manifieste ninguno de estos dos fenómenos; pero entonces se observa un aumento de volumen, como consecuencia del estado latente del calor.

Los cambios físicos y químicos que ocurren en un metal o sus ligas, se llaman puntos críticos, y corresponden a una variación en las propiedades físicas, como dureza, tenacidad, magnetismo, conductiblidad, microestructura, etc. etc., y la investigación de ellos (Puntos críticos) constituye el objeto del **análisis térmico.**

Los puntos críticos se determinan por medio de los gráficos llamados **curvas de enfriamiento.** Para construirlas se calienta un cuerpo, a una temperatura mayor que la de su punto de fusión, y se le deja enfriar después al contacto de un ambiente de temperatura constante: localizando después en dos ejes rectangulares, una serie de puntos cuyas coordenadas sean la temperatura y el tiempo de enfriamiento, resulta la curva, al unir estos puntos con una línea continua.

Antes de seguir adelante conviene definir algunos términos.

2.—Polimorfismo.—Dimorfismo.

El primero se refiere a aquellas sustancias que pueden presentar diversas formas cristalinas, y el segundo, a las que sólo pueden tener dos. Las causas más generales de estos cambios, son la temperatura y la presión.

3.—Isomerismo.—Alotropía.

El primero es la particularidad que tienen los cuerpos, de poseer propiedades físicas y químicas diferentes, teniendo la misma composición química. Puede ser físico o químico, según que el fenómeno sea debido a un arreglamiento **molecular** del cuerpo o **atómico** de sus moléculas.

La alotropía es el isomerismo de las moléculas. Ejemplo el oxígeno y el ozono.

4.—Isomorfismo.

Es la propiedad que tienen las sustancias de composición química semejante de cristalizar en los mismos sistemas cristalinos, siendo capaces de formar cristales mezclados, como los carbonatos de Ca. y Mg.

5.—Morfotropismo.

Se llaman series morfotrópicas, las que forman ciertas sustancias de radical químico compuesto, cuando según la proporción en que figuren las bases en el radical, el sistema de cristalización se modifica. En mineralogía tenemos un ejemplo típico en el grupo de los piroxenos. Su fórmula general es R. Si O$_3$, en que R es un radical compuesto principalmente de Fe, Mg, Mn y Ca.

La enstatita, por ejemplo (silicato de Mg. y otras bases) (Fe, Ca, Mn), cristaliza en el sistema orthorhómbico: si agregamos CaO, los cristales experimentan cierta deformación, sin que el sistema se cambie; pero llega un momento en que la proporción del CaO es tal, que el sistema pasa al monoclínico, resultando entonces el mineral llamado Diopsida.

6.—Soluciones sólidas.

Este término fué usado primeramente por Van't-Hoff, para ciertas soluciones de cuerpos sólidos en estado fluido, que tenían propiedades muy análogas a las de las soluciones líquidas, como la homogeneidad, por ejemplo. Según este autor, podían ocurrir en sustancias cristalinas o amorfas. En este estudio sólo consideremos como tales las amorfas que no absorben ni desarrollan calor (calor de solución) al pasar de su estado líquido al sólido, como el vidrio y algunos silicatos.

7.—Cristales mezclados.

Este término se refiere a algunas sustancias cristalinas que entran como términos de las series isomórficas y morfotrópicas. Por ejemplo la **dolomita,** que se compone de cristales mezclados de carbonato de Mg. y carbonato de Ca. Los cristales mezclados no tienen siempre la misma proporción de sus componentes. Como es claro, en las sustancias isomórficas habrá una sola serie de cristales mezclados, mientras que en las morfotrópicas habrá dos, por ser el morfotropismo un insomorfismo parcial, pues en las series morfotrópicas ocurren dos isomórficas distintas.

De aquí que la distinción entre cristales mezclados y soluciones sólidas sea, que en el primer caso la sustancia es cristalina y en el segundo amorfa. Además, al formarse los primeros, la congelación del cuerpo se hace con manifestaciones del **calor de solución,** lo que no ocurre en las soluciones sólidas.

II.—Curvas de enfriamiento.

1. Curva teórica de enfriamiento. (Su teoría matemática).—2. Curva de enfriamiento del Hierro Electrolítico.—3. Curva de enfriamiento del Hierro Fundido(Cast-iron).—4. Curvas de Osmond.—5. Construcción de curvas y precauciones.—6. Clasificación de los sistemas binarios en lo relativo a su punto de fusión.

1.—Curva teórica del enfriamiento de una sustancia simple, sin puntos críticos. (Teoría matemática del enfriamiento).

Sean:

A=Temperatura inicial de un cuerpo.

Y=Temperatura del mismo en un momento cualquiera.

a=Temperatura del ambiente, en contacto del cual ocurre el enfriamiento.

(*) Escrito por el Sr. Juan de D. Higuita L. en Anales de la Escuela N. de Minas.

K_1=Cocficiente de la ley de radiacion de Newton.

T=Tiempo de enfriamiento, correspondiente a la temperatura Y.

K=Constante integración.

C_1=Calor específico del cuerpo.

P=Peso del mismo.

e=Base del sistema neperiano de Logaritmos.

Según la ley de radiación de Newton, ella es proporcional a la diferencia de temperatura de los cuerpos en contacto; por consiguiente, la cantidad de calor irradiada, en la unidad de tiempo, por la unidad de peso será:

K_1 (Y—a), y en el tiempo diferencial en que pueda considerarse como constante el factor (Y—a), será:

K_1 (Y—a) dT. Para el peso P tendríamos:

$$K_1P\ (Y—a)\ dT.....(1)$$

Además, el calor perdido por el cuerpo en el tiempo dT, sería:

$$—PC_1dy.....(2)$$

El signo menos (—) se ha tomado por ser la temperatura una función decreciente del tiempo. Como (1) es necesariamente igual a (2), tenemos:

$$—PC_1\ dy=K_1P\ (Y—a)\ dT.$$

$$\frac{dy}{Y—a}=\frac{K_1}{C_1}$$

Integrando tenemos:

$$Log_e\ [Y—a]=-\frac{K_1}{C_1}T+K$$

$\frac{K_1}{C_1}$=C. tenemos:

$$Log\ (Y—a)=—CT+K.....(3)$$

$$Y—a=e^{(—CT+K)}.....(4)$$

que es la misma ecuación que trae Fulton, con la difencia de que C no es el calor específico del cuerpo, sino una función inversa de él. $\left|C=\frac{K_1}{C_1}\right|$

En ecuación (3) K puede ser determinada para cada caso particular, teniendo en cuenta las condiciones del problema, por ser constante de integración. Así para Y=A sabemos que T=o.

Estos valores en (3) dan:

$$Log_e\ [A—a]=K.\ \text{Luego}$$

$$Log_e\ [Y—a]=—CT\ \ Log_e\ [A-a],\ \text{o sea}$$

$$Log_e\left|\frac{Y—a}{A—a}\right|=—CT.....[5]$$

y

$$Y—a=(A—a)\ e^{(-CT)}.....(6)$$

Construida esta curva, tomando Y como ordenada y T como abscisa, se obtiene la de la fig. 1.

Según (5) para (y-a)=o, Log O=—CT pero Log O=—∞ luego—∞ =—CTy T=∞. Luego y—a=o es la ecuación de una asíntota: construida da la línea m n.

Por consiguiente, la curva parte de A y tiende a ser tangente a la línea mn, su asíntota, pues teóricamente nunca podría bajar la temperatura Y al valor a, temperatura del ambiente. Tal es la curva de una verdadera **Solución sólida.**

Nota.—Cuanto he dicho en lo relativo a esta ecuación es investigación propia, que muy especialmente someto a la consideración del Consejo.

2.—Curva de enfriamiento del hierro electrolítico.

Empezando con A=16000° C., se obtiene la curva AB, fig. 2, en que los puntos críticos están representados por anormalidades en la curva teórica de enfriamiento. En a, a la temperatura de 1550° próxima, ocurre el punto de congelación: la curva es horizontal, lo que implica un desarrollo de calor igual al que va perdiendo por radiación.

En b, a la temperatura de 880° C. próx., es el paso del hierro al hierro (Punto dimórfico).

En c, a la temp. de 780° C., es el cambio del hierro al hierro (Punto dimórfico).

Este último coincide con la readquisición del magnetismo, que con el calentamiento se había perdido.

Una curva puede construirse del mismo modo, durante el calentamiento del cuerpo.

Los puntos críticos b y c no coinciden ya con sus correspondientes b y c, pues sólo aparecen a los 800° y 905° C., respectivamente: ese fenómeno es conocido con el nombre de **Histéresis**, llamado **inercia molecular.**

Se observa que la convexidad hacia el origen de coordenadas indica enfriamiento rápido, y la concavidad lo contrario.

3.—Curva de enfriamiento del hierro fundido.

Es este cuerpo una de las aleaciones de la serie hierro-carbón.

Empieza en A=1260° C. próx. De A a a la curva es convexa, y en a ocurre la primera inflexión a 1176° C. próximamente.

De a a b es cóncava, lo que implica un desarrollo de calor, debido a la congelación entre la mezcla, de la sustancia llamada austenita (otra solución de carbón en hierro). Este fenómeno es de gran importancia industrial; se le conoce con el nombre de **congelación selectiva**, y bajo el punto de congelación del metal-madre, por lo que puede permanecer aún fundido.

En b el metal-madre se solidifica en la forma de un conglomerado llamado **Eutéctico.**

En b se observa una depresión de la curva, y luego un levantamiento durante la congelación del eutécnico; es el fenómeno de la **sobrefusión**, puesto que la sustancia se ha conservado al estado líquido en condiciones de temperatura inferiores a la de su punto de solidificación. Es este otro ejemplo de inercia molecular o histéresis.

El oro puro, la plata y el cobre presentan casos de sobrefusión. El zinc puede permanecer fundido 20° C. abajo de su punto de congelación.

4.—Método de Osmond, para construir curvas de enfriamiento.

Si en la curva de enfriamiento AB tomamos los intervalos x,' x," etc., etc., correspondientes al mismo cambio de temperatura Y_n, y construimos una curva representativa de estas variaciones, usando las temperaturas de 10° en 10° C, por ejemplo, obtendremos una de enfriamiento, caracterizada especialmente, por indicar con exageración los puntos críticos; pero tiene el inconveniente de no indicar la temperatura precisa en que ocurren, por ser ésta observada en variaciones relativamente grandes. Estas son las llamadas curvas de Osmond.

5.—Construcción de curvas.—Precauciones.

En un pequeño horno de gas o eléctrico se colocan unos 20 a 25 gramos del metal en un crisol de grafito, y se calienta hasta unos 50° a 100° C., arriba del punto de fusión. El tubo protector de cuarzo, donde va la copla-térmica destinada a conocer la temperatura, se introduce en la sustancia fundida; se hacen las conexiones convenientes de galvanómetro, y cuando la temperatura haya alcanzado un estado de equilibrio, el gas o la corriente eléctrica se suspenden, y el horno y su contenido se dejan enfriar tranquilamente, anotando cada 10" o 30" segundos, el tiempo, y el voltaje del galvanómetro (milivolts): de estos datos se deducen por conversiones sencillas las variables, temperatura y tiempo de la curva de enfriamiento.

Es evidente que las anormalidades de las curvas pueden ser debidas no sólo a cambios internos del cuerpo, sino también a perturbaciones externas (del ambiente en que se verifica el enfriamiento, por ejemplo).

Este inconveniente se evita calentando al mismo tiempo que la sustancia por analizar otra neutra (sin puntos críticos), como el platino o la porcelana, en el mismo horno y hallando su curva de enfriamiento. De este modo puede discernirse fácilmente si las inflexiones o anormalidades observadas en la curva primera son debidas a cambios internos—(en cuyo caso la segunda curva seguirá su forma teórica)—o si se deben a perturbaciones externas, pues en este último caso existirán dichas anormalidades en ambas curvas.

6.—Clasificación de los sistemas binarios en lo relativo a su punto de fusión.

Para concluir diré que una de las mayores aplicaciones del análisis térmico, es la determinación del punto de congelación de las aleaciones binarias y ternarias. Expirementalmente se ha llegado a deducir leyes generales a este respecto, sobre todo para las aleaciones binarias.

Estas se han clasificado en dos grandes grupos, a saber:

I.—Cuando las dos sustancias no forman compuestos químicos.

II.—Cuando las dos sustancias forman compuestos químicos.

Cada uno de estos dos grupos tiene hasta cuatro divisiones, según que:

A.—Las dos sustancias sean recíprocamente solubles en todas proporciones en estado líquido, pero completamente insolubles en el sólido.

C.—Las dos sustancias sean recíprocamente solubles en todas proporciones en estado líquido, y sólo parcialmente al estado sólido.

D.—Las dos sustancias sean sólo parcialmente recíprocamente solubles al estado líquido, siendo la solubilidad en este caso una función de la temperatura.

Estas divisiones a su vez tienen subdivisiones relativas a la presencia de eutécticos, disminución del punto de fusión respecto del de los dos componentes, o sólo de uno de ellos, etc., etc.

La clasificación ha sido basada principalmente en los estudios de B. Roozeboom's.

Ladrillos Combustibles de Turba

Ladrillos combustibles de Turba.

Debido al aumento de precio que a diario van experimentando todos los combustibles, procuran hoy los hombres de ciencia que a estas materias consagran su esfuerzo, hallar no sólo nuevas fuentes de provisión sino medios adecuados para conservar y utilizar hasta donde más fuere posible las existentes. Obedece a ello el que hoy se mire con tanto interés el aprovechamiento de la turba y de los residuos de ciertos combustibles por medio de su conversión en ladrillos concentrados.

El ladrillo combustible debe ser duro y consistente de tal modo que resista el transporte si quebrarse; no debe contener azufre ni desintegrase al ser quemado en las estufas o metidos bajo las calderas; no debe producir ni olor ni hollín ni escoria y no debe contener más de un 6 a un 10 por ciento de ceniza.

Todas las naciones se han esforzado siempre por producir, a bajo costo y con un imperceptible aumento de ceniza, un concentrado que tenga alto valor calorífico. Ultimamente, el Dr. George W. Herbein ha logrado combinar el petróleo crudo con la turba sin aumentar en más de 1/1.000 por ciento la proporción de ceniza y empleando una sustancia intermediaria cuyo precio es sólo de unos cuantos centavos.

Petróleo crudo del que queda como residuo en las refinerías y aceites gruesos de desperdicios es todo lo que se necesita para producir el "Carbón Herbein." Tales aceites son de precio muy bajo y se encuentran constantemente en el mercado. En California, Oklahoma, Texas, Cuba, México y Rusia, vale cada barril de 65 centavos a $1.20 o $1.44.

La detrina, sustancia que se obtiene del maíz y la cual se emplea comunmente para la manufactura del mucílago ordinario, la fabricación de papel, el estampado de telas, los sobres de cartas y los sellos adhesivos, sólo alcanza un precio de $3.30 por cada cien libras.

La cal apagada ordinaria tiene un precio que varía, según la localidad, de $8 a $14 la tonelada.

El principal objeto perseguido por el inventor fué el hallazgo de una sustancia intermediaria cuyas cenizas no repretasen más de un 1/1.000 por ciento en cada tonelada, que no tuviese un costo mayor de 8 centavos por cada 2,000 libras, que fuera abundante en el mercado y que quemase en las estufas ordinarias sin romperse ni desintegrarse.

Para fabricar los ladrillos de turba Herbein, se añaden a cada tonelada de esta sustancia medio barril de petróleo crudo, dos libras de destrina y dos de cal. Esta mezcla se comprime y da al expendio en ladrillos densos, duros, negros, inrompibles durante el transporte, que pueden acondicionarse perfectamente en cualquier estufa u hornillo, que entran en ignición fácilmente, que arden con lentitud dando una llama grande y clara y que no producen hollín. Sus cenizas representan de un 6 a un 8 por ciento y son tan finas como las de la madera.

Su valor calorífico varía de 10,000 a 11,000 B. T. U., según la cantidad de petróleo crudo que se le agregue y su valor es, más o menos, de $1.15 a $2.15 por tonelda.

Provechosa Aplicación de la Escoria

Los ingenieros y constructores miran en la actualidad con gran interés el estudio que sobre los materiales de construcción se están haciendo con objeto de disminuir el peso en las construcciones de cemento armado, obteniendo grandes ventajas en este empleo la escoria.

En vista de lo satisfactorio de los resultados que se observaron en los primeros experimentos en varias ciudades de importancia, las Leyes sobre erección de edificios permiten hoy que se use la escoria al igual de los otros materiales que comunmente se mezclan con el concreto para obtener el fin antedicho. Hace poco, para llevar a cabo una serie de pruebas sobre este mismo punto, se fabricaron quinientos bloques cúbicos los cuales se destinaban a ser triturados y examinados en la formá siguiente: 100 después de un período de 28 días, 100 después de 3 meses, 100 después 6 meses, 100 a los 9 meses y los 10 restantes al año. A medida que se avanzó en dichos experimentos, lo sresultados fueron tales que el número de cubos destinados a la prueba después de los seis meses y de un año se redujo a 50, a la vez que se resolvió triturar el resto en un período de seis años, por grupo de 10 y con intervalos de seis meses. Los materiales empleados para esta prueba fueron los que comunmente se expenden en el mercado y la manipulación de ellos se hizo tal como es costumbre en esta clase de trabajos. Para obtener una unión perfecta, la mezcla de los materiales se ejecutó a mano. El cemento usado fué uno de los que más comunmente se emplea en las construcciones y el cual cumplía con todos los requisitos que exige la "American Society for Testing Materials."

La arena era de Jersey. Este material no puede considerarse como de buena clase, pero se hizo uso de él por ser el que comunmente se encuentra en el mercado.

La escoria, que era de la comercialmente conocida con el nombre de "material de cuarto de pulgada" pasó por la criba de 1¼ y fué retenida por la de 1½ pulgadas.

La mezcla se hizo en las proporciones siguientes: una parte de cemento, dos partes de arena y cuatro partes de escoria. Se le dió la consistencia ordinaria.

Los cubos fueron colocados en un sitio seco y se les roció con agua una vez a la semana. De las pruebas respectivas apareció que la resistencia de compresión, por pulgada cuadrada, era la siguiente: a los 28 días, 1,561 libras; a los 3 meses, 1,952 libras; a los 6 meses, 2,859 libras; a los 9 meses, 2,841 libras; al año, 2,797 libras. Aunque, individualmente, algunas de estas cifras son inferiores al promedio ordinario de resistencia, consideradas en general pueden tenerse como muy satisfactorias, máxime si se toma en cuenta que la arena usada no era de buena calidad y que el tamaño comparativamente reducido de la escoria tuvo que disminuir naturalmente la fuerza del concreto. Sin duda alguna cuando este material es más grueso, la resistencia de la mezcla es mucho mayor.

Aquellos resultados indican que la escoria puede competir para estos fines con el cascajo, la arena gruesa y demás materiales, puesto que la resistencia media de ellos, mezclados en las condiciones ordinarias y después de 30 días, es de 1,500 libras por pulgada cuadrada.

Para batir el oro se le coloca sobre una badana puesta encima de un bloque de granito y se le golpea con un martillo de madera que pesa de siete a ocho libras. El oro que generalmente se emplea para esto es de 22 o 23 quilates. Para aumentar su expansibilidad se le liga con una pequeña cantidad de plata o de cobre. Sería imposible batir oro completamente puro.

Las hojas de oro se empacan más con ayuda del aliento que con las manos. La operación de trasladar una hoja de oro, casi transparente, de un sitio a otro, es de tal modo delicada que no puede efectuarse sino soplándola poco a poco y suavemente. Esta tarea se confía generalmente a las mujeres, quienes toman la hoja, tal como queda después de la batidura, con unas pinzas de madera, la llevan a una almohadilla de badana, la extienden soplando sobre ella con gran cuidado, la cortan en pedazos cuadrados, y meten estos entre las hojas de los "libros" respectivos acondicionándolas allí por medio del aliento. Cada libro lleva 25 hojas de oro. Una operaria hábil puede empacar setenta libros diariamente.

Descubrimiento Casual de Algunas Minas

Hce algunos años, dos buscadores de minas fueron contratados para tal tarea por el dueño de una licorería situada en un pueblo cercano al que hoy es Distrito de Coeur d'Alene, Idaho. Se les dió un burro para que llevaran en él sus provisiones y utensilios. Por repetidas veces, los dos hombres anduvieron en busca de los ambicionados depósitos. Después de algún tiempo—descorazonados e irascibles—surgió entre los dos un disgusto y resolvieron separarse dividiendo previamente sus haberes. Echó el uno montaña abajo y el otro, a quien habían tocado en el reparto la escopeta y el burro, fué en busca de éste y lo halló, en la parte alta, precisamente sobre la cabeza del filón de la que hoy es una de las minas que mejores dividendos pagan en aquel Distrito.

En los primeros días de explotación de la mina de Granite Mountain—que ha producido millones de pesos—y cuando las excavaciones tenían cerca de 100 pies de profundidad, se emprendió, en el fondo, la apertura de una galería. Era costumbre de los mineros que en esto trabajaban, hacer taladros. cargarlos con pólvora y efectuar la voladura de ellos; con tal fin se les suministraba un número suficiente de cartuchos explosivos. La roca ofrecía una extremada dureza y, como el sobrestante de tales trabajos no era persona muy estricta, sucedía que ciertos mineros, por ahorrarse el trabajo de abrir los taladros, escondían algunos cartuchos de pólvora tirándolos, por las junturas, tras de la armazón de madera acondicionada en el fondo. Cierto día, uno de los mineros tiró por allí mismo un cartucho con la mecha encendida. La explosión fué tan terrible que ella reveló la treta de que venían valiéndose los obreros para esconder la pólvora, pero, al mismo tiempo, abrió otra vena paralela que resultó ser extraordinariamente rica.

Un individuo que había sido, en tiempos anteriores, condueño de una mina, viajaba a pié en los comienzos del año 70, por el camino real que vá de Red Mountain a Irontón, Colorado; para tomar algún descanso, se sentó, a la orilla del camino bajo la sombre de un árbol; como cerca había una roca y como el viajero llevase consigo una pequeña pica de explorador, se le ocurrió arrancar de allí un pedazo y encontró que era galena. Después de una hora de exploración en la montaña, descubrió la veta de una mina por sobre la que cientos de mineros expertos habían pasado antes sin sospechar siquiera su existencia. El individuo en cuestión extrajo de allí oro por valor de $20,000 y luego vendió sus derechos por $70,000.

En Camp Bird, cerca de Ouray, Colorado, los obreros que verificaban los trabajos anuales de amillaramiento, durante el fin del otoño, hallaron, en la roca que cortaban, un material distinto del común. Debido a una fuerte nevada, los trabajadores hubieron de abandonar tal propiedad precipitadamente, olvidando tomar muestras del nuevo material encontrado. Posteriormente se descubrió que aquellos fragmentos de roca que habían sido tirados como inútiles, al terrero, eran un quijo mineral riquísimo, y esto condujo al hallazgo de la muy conocida mina de Camp Bird.

Años atrás, un individuo a quien se acababa de nombrar Administrador de las Minas de Delamar Trade Dollar, encontró, examinando un terrero formado antes de su llegada allí, un cierto material extraño que había sido botado entre aquel montón inútil. Al examinar cuidadosamente pudo comprobar que era rico mineral de plata. Poco tiempo después de aquella, por alguna causa insignificante, tal Administrador fué despedido. Posteriormente, el mismo dueño descubrió la existencia de aquel quijo en su mina y vió, para propia vergüenza, que había estado, por mucho tiempo, arrojando tal roca mineral al terrero.

La buena suerte de una dama, esposa del primitivo descubridor de la Mina Enterprise, en Rico, Colorado, determinó el hallazgo de ésta. En la empresa de excavar y desecar el socavón de una mina de su propiedad, sin éxito alguno, tal individuo había contraído deudas de gran significación. Por aquel tiempo, su esposa ganó un premio de $4,000 en la Lotería de Luisiana y tuvo el valor suficiente para invertirlos en los trabajos de la mina, adquiriendo, así, el derecho a la mitad de las ganancias que se pudieran obtener. Con esto quedó su esposo en aptitud de hacer nuevas excavaciones hasta que al fin halló un filón pequeño y. guiándose por éste, pudo descubrir la veta principal en las propiedades adyacentes. Después de haber extraído de allí oro por valor de un millón de dólares la mina fué vendida por $1.250,000

La mina de Tomboy en Telluride, Colorado, cuando apenas se principiaba a explotarla y como sus indicaciones superficiales fuesen muy pobres, pasó a propiedad de un quincallero, en pago de una deuda de $1,200. Debióse a esto su posterior desarrollo y el que viniera a ser una productiva mina que, tiempo después, fué vendida a una compañía inglesa por más de un millón de dólares. Actualmente, todavía paga dividendos.

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Patents and Research.

Developments arising out of the introduction of two conspicuous improvements in metallurgical practice invite comparison as well as thought concerning the wisdom of conferring the benefits of a so-called invention upon a single individual when that invention is merely an improvement which requires time for its development and the work of many for its perfection.

The Cottrell process for the electrical precipitation of suspended particles, which is of such importance in controlling the smelter fume nuisance and promises to be even more useful in purifying gases produced in gas plants, is as nearly a true invention as possible in the steady, slow march of industrial progress. Doctor Cottrell and his three associates not only studied the principles of electrical precipitation, but they gave their own time and money for perfecting the process and applying it to practical conditions. In 1911 when this little group of chemical enthusiasts saw their enterprise developing into a dividend paying concern, they offered to transfer to the Smithsonian Institution all the rights in the inventions and patents, in order that the profits resulting from the application of the patents, already well assured, might be applied to the advancement of scientific research and investigation." It was Dr. Cottrell's ideal to render discovery already made the mother of new discovery, and thus contribute to the scientific and technical development of the industrial arts."

For administrative reasons a "Research Corporation" was substituted for the Smithsonian Institution as the custodian of the Cottrell endowment. This corporation, prohibited in its charter from paying dividends, succeeded in two years in installing the precesses in various industries throughout the United States and thus earning the $20,000 required as capital by the charter of the corporation, and a fund of $100,000 for scientific research.

Now compare this admirable history with that of the development of the flotation process, the principles of which are not half understood and which is and has been enveloped in a snarl of litigation, secrecy, claims and counter claims. Many had observed that certain minerals would under certain conditions float upon water, and many had tried to turn it to industrial advantage, but with varying success. Then a corporation secured a comprehensive patent on a machine employing the flotation principle under conditions still largely experimental. Another rival concern set up a counter claim also comprehensive, and the endless series of lawsuits began . In the meantime the value of the principle, if not the machine, was recognized, and the real development of the process began. But the owners of the machine patents claimed that every use of the principle, however applied, was an infringement of their own rights, which imposed secrecy

on all investigations until such time as the courts might decide as to the rights of the various claimants. Thus the matter stands. A vast amount of useful work has been done, but none of it is available for the use of those who are developing the process. It is impossible to compare results and to develop a sane parctice, because the claimants destroy all results and all apparatus used in an investigation as soon as the test is completed. It is needless to point out how this condition must retard the perfection of a process so sensitive as is the flotation process to a great number of minute physical variations. .

How it will end no one can venture to predict. Perbably no one clainant will profit enormously from the application of a principle which so many have helped to develop. That flotation will be of immense value in the metallurgical treatment, especially of low-grade, ores is already assured. In the meantime there will be many stumbling, halfbaked attemps and many failures, all because the natural development of a useful process has been halted and interfered with in order to enrich a few individuals.

How much better it would be to turn over the entire mess to the Cottrell Research Corporation and allow the industry as a whole to reap the benefit.

Recovery of the Metal Markets.

Although at the present writing Mexico City is still cut off from the world's news centers, an occasional hint is begining to filter through and to show that the prices of metals have begun to have an upward tendency some time ago. Silver is reported above 50 cents; copper slightly better than 17 cents and lead well above 4 cents. That is considerably better than our last direct quotations in Janaury when silver was well below 50 cents and copper stood at about 13.50.

Apparently the world is adjusting itself to the conditions of war and is resuming a greater consumption of metals. Except for a comparatively small area about the British Islands, the war has ceased to interfere greatly with commerce on the high seas, and neutral countries are recovering from the shock and the depression due to the sudden dislocation of things, which is war. This resumption of interest in metals, the basic materials of civilization, must be greatly encouraging to the mining industry everywhere and would be to us if we had that other essential element of civilization, communication with the rest of the world.

As to the causes of the rise in silver it is rarely possible, even in normal times, to make more than a hopeful guess. The silver market is bound up in the affairs of England and the far East. Probably India, China and Japan are finding their lost confidence and are beginning to take their normal quantity of their favorite white metal. Possibly the reduced production in Mexico may also have its influence.

Copper and lead both enter largely into the manufacture of war material, but it may be doubted whether the demand from this source could ever equal that of normal industrial activity. Copper production had been voluntarily reduced in the early months of the war to probably about three-fourths of the normal output in the United States and elsewhere. That and the involuntary reduction of output in Mexico, must have quickly cut into the supplies on hand. The copper industry of Germany soon ceased to influence the outside world. That country as a market for the metal also ceased to exist. But it soon became evident that a large proportion of the copper imported into that country was sooner or later exported to other countries in the form of wire and other manufactures. Much of the copper formerly taken by Germany now goes directly to its final destination without passing through that country.

The need of copper in the industries, in good times and bad, is so enormous that it was early predicted that the diminished production would reduce the available supplies so rapidly that it would be impossible to resume normal production fast enough to prevent a shortage and a considerable rise in prices, experts predicting 20-cent copper during the present spring Something of this sort seems to have taken place, and the horrors of war are not quite so horrible to the miners of neutral countries.

Unfortunately Mexico is not yet in a position to take its share in the coming prosperity.

Dark and Desperate Characters.

The item below does not refer to the poor, despised foreigner in Mexico. It is a mild protest which appeared recently in the columns of the Alaska and Northwest Mining Journal:—

"Again the blow has fallen, and again Washington has declared its unalterable conviction that no matter how upright and honorable a man may have been up to the time he came to Alaska, he was from that time a dark and desperate character from whom all justice should be withheld."

Mine, Quarry & Derrick.

Recently one of the infrequent mails brought to this office a copy of a new mining journal. It is an attractive youngster and sails under the comprehensive title, Mine, Quarry and Derrick. Its second number breathes an air of youthful optimism and a trust in the willingness of everybody to deal fairly with those of good and noble intentions that is welcome and refreshing in this extremely old and wicked world. Mine, Quarry and Derrick means to tell the truth always and under all circumstances, even about its own budding circulation and about the occasionally wicked advertiser who tries "to put something over" on a trusting public.

May the optimism of this youngest of the mining journals never fade, and may the sneers of the worldly never turn its sweetness into bitterness, a fate that has befallen more than one of its predecessors in the same field.

Coal-Dust Fired Reverberatories.

The convenience and regularity of operating rever-

beratory smelting furnaces with fuel oil has led to attempts to do away with the grate and fire-box in furnaces heated with coal. Several trials were made with furnaces fired with pulverized coal introduced with a blast of air, but no conspicuous results were obtained until D. H. Browne and his associates at Copper Cliff, Canada, made a thorough study of the conditions necessary and favorable for the use of fuel in dust form. The results were so satisfactory that the plan has been adopted elsewhere, with results so favorable in the way of tonnage and economy that firing with coal dust promises to replace all other methods of operating reverberatory smelting furnaces.

At the Washoe Reduction Works, in Montana, two similar furnaces were opearted in parallel, one being fired on the usual grate and the other mechanically with coal dust. The furnace employing the usual intermittent firing with shovels and slice-bar smelted 251 tons of charge per ady while the one fitted with blower and dust pipe smelted 476 tons, the quality of coal being the same and the amount consumed almost the same. Mr. Browne, who has done more than any one else to perfect the method, says of coal-dust-fired reverberatory smelting that "My belief is that reverberatory smelting along these lines will become cheaper than blast-furnace smelting and that a wider range of ores can be used in such a furnace than in the old style coal or oil fuel furnaces."

Among the advantages of operating furnaces in this way are given the following:—"The great advantage of coal-dust firing is the absence of the usual breaks in the temperature curve due to grating or cleaning the hearth, and as a consequence a greatly increased tonnage and fuel ratio. The operation of firing, being purely mechanical, comes under the immediate and direct control of the furnace foreman and responds instantly to his regulation. In addition to this the peculiar method of feeding by almost continuous side charging obviates the breaks in the temperature curve due to charging or ordinary fettling. For these two reason the chart of the temperature shows an almost unbroken horizontal line, rising and falling in almost exact accordance with the speed of the coal feeding device."

An important feature of the practice is that of feeding along the walls of the furnace in small quantities at time. Thus the side walls are always protected by a dam of comparatively cold unfused material which effectually protects the wall at the surface of the charge. The new practice seems to make the operation of the reverberatory continuous in fact as well as in theory, and thus robs the blast furnace of the only advantage it ever had over the reverberatory.

The Shortage of Manganesse Ores.

Of late years prospectors in Mexico have avoided deposits showing manganese, because ores carrying this element were commonly supposed to be difficult to treat by cyaniding for silver. Now it might be good business to prospect for manganese for its own sake. The European war has interfered with the normal supply to the United States tu such an extent that prices of manganese ores and their products have practically doubled. Ferromanganese, a pig iron containing from 60 to 80 per cent manganese, which normally sells for about 40 dollars a ton was sold for a price as high as $140 per ton in the closing months of the year.

The war has made necessary a number of changes in the industries which use manganese and its products. The English steel industry depends largely upon ferromanganese made from ores shipped from India and Russia. The supply from India is probably secure even if the Turks were to take the Suez canal which now seems unlikely. The supply from Russia is completely cut of, at least until the Dardanelles can be reopened for traffic. Germany has little or no manganese ore within its borders, and unless provision had been made before the disturbance began, the steel industry in that country may experience a manganese famine. In normal times Germany imports the bulk of its manganese ore from Russia, but so long as the war lasts the Muscovites will see to it that none crosses the border.

In the United States new sources of supply of manganese are being sought, and mines which had been idle have been opened up. All in all the oxides of manganese promise to be valuable minerals for some time to come. In view of the abundance of manganese in the silver-bearing ores in certain parts of Mexico, experiments with a view of producing manganiferous material as a by-product in cyaniding would be interesting.

What is Ore?

There have many attempts to define the word "ore", but no definition, not even that which we memorized in college, has received general acceptance. After many years of discussion we are no nearer to a general agreement than ever. Usually when there is a discussion on concerning the nature or idiosyncracies of deposits, the speaker begins by explaining what he means by the term ore, very often the question of agreement or disagreement hinges on whether his hearers accept or reject his preliminary definition.

Most of the current definitions include a statement in effect that minerals to be 'ores" must have enough value to yield a profit. This basic statement has been undermined by the announcement that the Hungarian government has for years worked its old lead and silver mines at a loss merely to keep the miners employed. According to the definition those mines do not produce ore at all. Furthermore, we have the very common expressions, "payable" and "unpayable" ores, which may be very inaccurate but which everybody seems to understand.

It may be true as the "peritos" of language assert that most of us could not explain in a month what we mean when we say "ore.". Nevertheless it is a very useful word and most of us will continue to use it and to have a very fair idea of what people mean when they say they have "struck ore" although they may not have the slightest idea as to its value.

Colonel Tepetate.

"Hey! "shouted the Pessimist," what do you think of that last telegram?"

But the Colonel pretended not to hear and dodged hastily into a side avenue of the Alameda. "Hm!" he muttered. "This is no place for an optimist these days." He strolled along enjoying the fresh green of the new leaves of the tree-tops and collided with his friend the machinery dealer.

"Hullo!" said the machinery man." Looking up, are you? First case of the kind I 've seen for many a day."

The old man smiled a little sheepishly. "How are cam-shafts and screens? he asked politely.

"Cam-shafts and screens! I haven't even thought of them for weeks and months. Say, what do you think of that last tel—"

In the distance the old man spied the manager of a mine that he knew to be in operation. He chirked up and hastened to join him.

"Yes, still running and doing well, "said the manager in response to the usual inquiry." But—we haven't the least idea how long we can keep it up."

"Labor costs are pretty low, aren't they? And the price of silver is a bit better," suggested the old man hopefully.

"What's the use of all that when you can't ship your bullion or get in supplies?" snapped the manager.

"But when the railroads once open up—"

"Railroads! "fairly shouted the manager." Did you say railroads? There aren't any railroads. All gone—burro trains and diligencias for ours. Say, what do you think—"

The Colonel continued his search something cheering, and presently sat down on a bench besides his old crony, Jim Daley, a veteran of the Crimean war and of mining camps throughout the world. He had some wonderful copper properties in the southern part of the country and had spent all he possessed in development. He had got a company and capital promised when the liberating army—the same old story. The old miner had lost most of his hearing and looked worn and a bit frayed. He cupped his hand behind his ear and said:—

"Don't talk to me about the war—the big war! I can't stand it. I have seen it; I know what it is."

So the Colonel sat with him in the sun while the veteran explained once more what a wonderful property he had and the wonderful country in which it was located. He extracted from his pockets blue-black specimens, which he had scarcely been able to get anybody to look at for more than three years. For a half hour old Jim had a pleasant time, but the talk did our Colonel very little good. He knew how the pathetic story would finally end. Presently he got up and joined an engineer who had recently returned from an examination trip.

"Are they interested in the Nipissing process in that petlanque country?" began the Colonel.

"Nobody is interested in nothing, "returned the engineer, ungrammatical for emphasis." A three weeks' job, and it took me three months to get back—walked most of the way, miles and miles between double tracked rails—twenty-four hours without a bite to eat—that is interesting."

"Flotation—"began the old man groping for a fresh start.

"A wonderful country," went on the engineer ignoring the interruption, "swept as clean as that street. Not an egg or a chicken or a burro left. Even the dogs are gone."

The Colonel saw that it was hopeless and walked on in silence for some time. Suddenly the engineer brisked up.

"Say," he said, "what do you think of that last—"

At the corner of the nameless street that was once called San Francisco, our optimist found a young man whom he knew had been waiting months for a chance to join his father at some mine. What is youth but hope?

"Next week I think I can get through, "said the young man. It had been "next week" for as long as the old man could remember. They had gone over all that before. So the Colonel tried a new tack.

"They've started a new mining paper in Calgary, Canada," he said. "It is an interesting experiment, all hign-brow altruism. I hope it works."

But the young man was too preoccupied to inquire the name of the new publication. "If they would only let us have our mail." he said absent-mindedly." At the club they've posted another tele"—

A block farther along, the old man saw the Pessimist making for him with determination in his eye. This time he did not try to escape.

The Colonel nodded to him. "It's your inning," he said."

"My inning! What do you mean?"

"I mean that you're it. It is your turn to do the talking." And he turned and slowly walked away.

The Pessimist watched his receding back and drooping shoulders for a few moments." He is begining to show his age," he said.

The first discovery of coal in the United States was made by Father Hennepin, a Jesuit missionary, who in 1679 reported the occurrence of "cole" on the banks of the Illinois river near the present city of Ottawa.

Thallium is a rare metal with a specific gravity of 11.81 to 11.91, and a melting point of 303°. It occurs in certain pyrites and in mineral waters. Physically and mechanically it is like lead, but chemically it also resembles the alkali metals in many respects. It is so soft that it can be cut with the finger nail. A freshly cut surface is lustrous, but rapidly becomes dull. The metal volatilizes a little above the melting point, and when heated before a blowpipe gives a reddish vapor having a peculiar smell. Hydrochloric acid attacks thallium slowly, while other acids dissolve it rapidly. The metal is generally extracted from the flue dust of furnaces in which pyrite containing the element is burned. This dust is treated with dilute sulphuric acid, and the thallium precipitated in a crystaline form by means of zinc. The chief use of the metal is in the manufacture of optical glass of high refractive power. Thallium is worth about $11 per pound.

Enormous Waste of Mineral Resources of United States.

A national loss of not less than $1,000,000 a day is a reasonable estimate of the present waste, in large measure unnecessary, of the mineral resources of the United States. Director John A. Holmes of the Bureau of Mines declares in his annual report that:

"At the present increasing rate at which we are using it, our one supply of a number of these resources will be either exhausted or largely depleted while the nation is yet in its youth.

"Of the several lines of mineral industry in which this waste calls for investigation, only two—of the most especial urgency and importance—are included in the urgent needs of the Bureau of Mines, namely, the waste and losses in coal mining and in petroleum operation. But the enactment of pending legislation in Congress providing for the establishment, mainly in metal mining States, of a number of mining experiment stations will render possible similar researches looking to the lessening or preventing of waste."

The bureau's work looking to the prevention of waste of natural gas by an expenditure of less than $15,000 during the past eighteen months has brought about a saving of natural gas worth not less than $15,000,000, a sum many times greater than the total cost of all the work done by the bureau during the four years of its existence.

Chemists and engineers of the bureau have demonstrated that a process they have devised for the extraction of radium from its ores can be successfully used on a large scale and will prove more efficient than that used by foreign producers of radium, that the cost of radium to the user will be reduced to one-third of the present price. The process is to be patented and dedicated to the public.

A careful preliminary inquiry shows that in mining 600,000,000 tons of coal yearly, 300,000,000 tons are wasted or left underground in unminable condition, Of this waste 200,000,000 tons is believed to be preventable. A preliminary inquiry to the coking of coal in beehive ovens has shown that the total value of the byproducts annually lost in this country through the use of such ovens amounts to $75,000,000. The annual waste of metals in brass furnace practice amounts to more than $4,500,000.

In conducting its campaign for greater safety and efficiency in the mining industries there has been adopted the following general plan of cooperation between the Government and other large agencies: (1) That the National Government conduct the necessary general inquiries and investigations and disseminate in such a manner as may prove most effective the information obtained and the conclusions reached; (2) that each State enact needed legislation and make ample provisions for the proper inspection of mining operations within its borders; (3) that the mine owners introduce improvements with a view to increasing safety and reducing waste of resources as rapidly as the practicability of such improvements is demonstrated; and (4) that the miners and mine managers cooperate both in making and in enforcing safety rules and regulations as rapidly as these are shown to be practicable. The States, the miners and mine owners and other agencies, such as the mining and engineering societies, are now showing a willingness to cooperate with the National Government in this work.

A discovery of deposits of petroleum in the State of Aalagoas, Brazil, is reported. The fields are said to extend over 250 square miles, and the oil to be of good quality.

State of Jalisco, Mexico.

The state of Jalisco is first in the Mexican Union in point of population, agriculture, stock raising and manufacturing industries. In area it comprises 86,740 square kilometers. It is bounded by the states of Durango, Zacatecas, Aguascalientes, Guanajuato, Michoacan and the Territory of Tepic, and has a Pacific coast line of 279 kilometers.

Map of Jalisco.

In the Spanish colonial epoch the name of New Galicia was given to that part of the Mexican Republic now divided into Jalisco, Aguascalientes, a part of Zacatecas, and the Territory of Tepic. The Spanish conquerors discovered in New Galicia, in the year 1522, a race of Indians called the Chimalhuacans, divided into three kingdoms: Xalisco, Tonalán and Etzatlán. Compostela was the first Spanish capital. Guadalajara, named after the ancient Wadil-ad-jara, of Old Moorish Spain, was made the military and political headquarters in 1542, occupying its present site on the San Juan River. The Spanish government was succeeded in 1810 by the Mexican revolutionists under Hidalgo, the liberator, and Jalisco in 1821 formed one of the states of the Mexican Republic, her first governor being Don Prisciliano Sánchez. In 1855 the State of Aguascalientes was organized, and in 1884 the Territory of Tepic was formed from Jalisco's broad domain.

This state is divided into twelve cantons, with headquarters in each as follows: Guadalajara, Lagos, La Barca, Sayula, Ameca, Autlán, Jocotepec, Colotlán, Zapotlán, Mascota, Teocaltiche, and Ahualulco. These correspond to county seats in the United States. Agencies of the Department of Fomento, Mining Branch, are located at Guadalajara, Ameca, Etzatlán, Hostotipaquillo, Mascota, Autlán, and Ciudad Guzmán, or Zapotlán, for the accommodation of those who desire to acquire mineral properties.

The climate of Jalisco is delightful. During the rainy season, from June to October, frequent showers make it the most pleasant time of the year. The average temperature of Guadalajara is 67.8 Farenheit, and throughout the state there is little variation, except on the coast in summertime. There are no destructive

winds, no winter weather and no drouths. Jalisco is the Italy of America.

The valleys of the state are among the richest in Mexico. From their fertile ranches come all sorts of products, live stock, and fruits. Wheat, corn, sugar cane, beans, fresh vegetables, cattle, hogs, sheep, horses and mules, etc., shipping to all parts of the country, make busy scenes at the National and Southern Pacific railway stations. From October to January the orange crop exported from the Atotonilco and La Barca district will reach about 1,000 carloads. In the Grand Canyon of the Santiago every variety of tropical fruit grows, as well as around the shores of Lake Chapala and on the Pacific slope. Vegetables of all kinds are abundant. Jalisco has more live stock than any other Mexican state. Importations of graded cattle, sheep and horses have improved the business wonderfully, and there are few ranchmen who have not invested heavily in high grade animals.

Jalisco offers an attractive field for mining investments, in the Sierra Madre range which extends through the western part. For three centuries operations have been carried on in this great mineral belt. The principal centers of activity are Autlán, Mascota, Ayutla, Ameca, Ahualulco, Etzatlán, Tapalpa, Tula, Hostotipaquillo and Bolaños. Millions of dollars of American capital have been invested in promising properties around these camps.

Modern methods are being installed by able companies and profitable operation has begun. The predominating ores are gold, silver, copper, lead and iron, which occur in large bodies and are easily susceptible of treatment with proper appliances.

Jalisco has more lakes than any other state, and rivers and small streams are abundant. Lake Chapala is the largest fresh water body in Mexico. It covers an area of 1,579 square kilometers, and is 75 kilometers in length. Five thousand feet above sea level, its altitude counteracts the effects of the tropical sun and the result is perpetual Indian summer. Around its shores are most fertile lands where any cereal or fruit can be grown, and on its placid surface an extensive boat traffic is growing up. Lake Chapala is the popular watering resort of the Republic. Ribera Castellanos, at the eastern end, is known as "The Riviera of Mexico." Chapala and Ocotlán are its principal towns, each a center of growing activity. Lakes Magdalena, Zapotlán, Tizapán, San Marcos, Atoyac, Sayula, Zacoalco and Cajititlán are extensive bodies of water and delightful resorts.

Eight large rivers traverse the state, fed by smaller ones, and flow into the Pacific. The largest is the Santiago, along the banks of which 15,000 h. p. electric power is generated for Guadalajara and suburbs. This is the second stream of the Republic, 872 kilometers long, with its source in the State of Mexico. The Grand Canyon of this important river is a most picturesque scene.

Prospecting for Tin.

Tin has been found in several localities in Mexico, and it may be to the advantage of mining men in the country to pe prepared to pass on the value of these deposits. Director Lincoln of the Mackay School of Mines spent last year in Bolivia the only important tin producing country in the western hemisphere, and makes the following suggestions in regard to prospectiong for tin:—

Cassiterite is practically the only tin ore. It is an oxide of tin. SnO_2 and when pure contains 79 per cent metallic tin. Cassiterite occurs both in placer deposits and in lodes, but up to the present time the greatest production has come from tin placers,—Bolivia being the only country whose principal production is from lodes. The rounded particles of cassiterite occuring in placers are called "stream tin."

Cassiterite is a hard, heavy, non-metalic mineral, ranging in color from light brown to black. It is most readily confused with the oxides of iron,—hematite and limonite,—but it is much heavier than these, having a specific garvity of 7 whereas limonite has one of 4 and hematite one of 5. Moreover, both the iron oxides are soluble in acid whereas cassiterite is not attacked even by aqua regia.

If the tin prospector carries into the field some muriatic acid, granulated zinc and a test tube, he can very readily test for cassiterite after the following manner: Place a piece of granulated zinc in the bottom of a test tube, put a fragment of the mineral to be tested on top of this and cover both zinc and mineral with muriatic acid. The zinc will then dissolve with violent bubbling due to the freeing of hydrogen and this nascent hydrogen will come in contact with the mineral. If the mineral is cassiterite, tin will be reduced on its surface, forming a silvery metallic coating. This adheres so storngly that if the specimen is rubbed it will polish the coating without detaching it. If, on the other hand, the fragment is not cassiterite, no such coating will be formed.

Placer tin deposits are in almost every way similar to placer gold deposits. The stream tin being heavier than the rest of the gravel, it works its way to bed rock where concentrated. Small quantities of fine tin may occur distributed throughout the upper part of the gravel, especially if the valley is large and the stream small. As the prospector works up stream toward the source of the tin, the particles of stream tin will become more angular and large,—just as the gold colors become rougher and larger as the prospector approaches a gold lode. Thus it is that prospecting for tin placers and tin lodes is in every respect similar to prospecting for gold placers and gold lodes, the only difference being it is somewhat more difficult to determine tin on sight.

*Persistence of Ore in Depth.**

By F. Hille.

It is not a rare experience to find otherwise clever professional men become, owing to over-confidence in their ability, often blindly one-sided, and sometimes even reckless in their conclusions and assertions regarding certain subjects.

This was again impressed upon me by reading an excerpt of a a paper by Mr. T. A. Rickard, entitled "Persistence of Ore in Depth," that was presented to the Institute of Mining and Metallurgy in London during its December meeting. Of course, the readers of Mr. Rickard's publications should be, by this time, well accustomed to his often brusque nonchalance, in treating certain topics, and this is repeated again in the above mentioned paper, the subject of which has become I might also say, his hobby. His illustrations used in trying to make a case, although very entertaining, should have hardly been necessary, because the subject is of sufficient interest and importance; however, "de gustibus non est disputandum," it is the underlying abrupt conclusiveness to which I object principally.

Everyone of any experience in economic geology knows how extremely hazardous it is to draw a parallel between two ore deposits in two different or even in one and the same locality, on account of the basic differences underlying, in most cases, their origin. How still more risky it is to attempt to treat in this matter

* From the Canadian Mining Journal.

the whole multitude of ore deposits, and to patch up, out of certain similitudes, a hypothesis that is to fit the whole question. The practical geologist or mining engineer finds in his mine or field operations very soon that the experience gained in one region or camp is not, or if so, but rarely, applicable in another. Therefore the quicker he discards his former experience or preconceived ideas the better for everyone concerned.

What is Depth?

Depth is the gist of the paper in question, but what does the author mean by "depth"? "Persistency of Ore in Depth," does not exist, he says. Why not? He does not explain. Now I thought every theory propounded had to be based on a law that is to prove its correctness, and that if this cannot be done, then the theory is wrong. To prove his contention by citing a few mines in which payable ore has not been found in depth, is no proof; because an equal number of other mines could be enumerated upon which the above assertion would not hold good. Even some of those very mines cited would disprove his contentions.

Depth is undoubtedly necessary in case of a low grade deposit, that is, if the width does not make up for a deficiency in the former, because the mass or quantity of the ore has, in this case, to be the profit bringer. With a rich deposit depth would not be so essential, at least not in the same measure as in the former, although, of course, desirable. Let me cite here the Cobalt silver mines which have paid largely even at shallow depth; the same can be said with some of the Port Arthur silver mines and of the Comstock. The money expended on these mines was surely not "the transferring the earnings of the many to the pockets of the few."

What depth then, in the opinion of Mr. Rickard, would be necessary to constitute a paying mine? Without knowing this, it is difficult to offer an effectual refutation of his claim. I do not attribute to him, as someone mentioned in discussing his paper, that he meant the depth of every ore deposit to cease only at its antipodian region; neither also that they need to go farther into the bowels of our globe than our present of future mining methods would permit. But he will not deny that 4,000 to 5,000 ft., at which a number of mines are working with a profit to-day, is not exactly a shallow depth. These same mines, who knows, may go even as many feet deeper yet without our finding the ground too poor for profitable working. And why should they not? How many mines would be in operation of equal depth or more to-day, had no erosion, glacial action or later plutonic activities deprived us of thousands of feet of those deposits of which we are working the truncated parts now.

However, depth is not the only factor in which we have to decide the value of an ore deposit. There are others equally as important, genetic occurrence, width, horizontal extent, mineralization, occupation and form in the rocks by which they are encased, communications, market, labor, etc., etc.

Now then, what is depth? Depth, as I understand it, is: (a) That place whence the contents of our metal veins originated, and (b) That place in which the contents of our metal veins found their lowest rest or seat.

In this class I include only such deposits as are produced by volcanic emanations.

(a) The place of origin is deep seated; plutonic rock intrusions, the source of gaseous emanations, may have come to rest in their upward pressure miles below our earth's surface, and in course of time gradually cooled to such an extent that a continued deposition of mineral matter reached down to almost its starting point.

(b) Apophyses of a volcanic rock injected into the upper horizon of our earth's crust created an exit for gas emanations along their course; but owing to the long retained heat of the rock the gases mingled with their own and meteoric waters, and then deposited their mineral contents close to the earth's surface, that is, in certain horizons of cooled rock strata.

Influence of Conditions.

It will be seen that between these two extremes, any depth would be produced according as the conditions were favorable one way or another.

Now to find out these depths involves a patient study of the stratigraphical geology, and an equally patient observation of the mining operations in progress in each mineral region.

During the course of our labors we will then have observed, also what role the rock or rocks of the immediate vicinity have played as affecting the distribution of the minerals and metals throughout them, whether they are formed in connecting solid deposits —veins—or scattered throughout a shattered rock, forming mineralized zones that may allow or not allow a profitable working. Further, we have to consider whether the mineral contents of veins were uniformly deposited or whether intermittently.

All these conditions give to each mineral district special characteristics which have to be considered in our calculations. If we enter upon our duty with an air of infallibility, or a notebook full of preconceived ideas that are dispensed upon every occasion, we usually damage ourselves as well as our clients, and, in no less a degree, the country or locality in which these deposits occur. Such superficialities are then, not merely excusable professional errors, but inexcusable professional sins.

And I am compelled to accuse Mr. Rickard of the latter when he claims that the ore deposits of the Rainy River district belong to that class, with no "persistence of ore in depth," and that consequently "they have had their day." Mr. Rickard will see the day when the deposits of that district will not only show depth, but will also show themselves to be the most important on this northern continent; some of them will rank with the Treadwell and Homestake, and some with the best of the Nevada mines. That these mines were closed in years gone by, was not due to the diminishing of values in the ore, or giving out of the ores. On the contrary, some of them have steadily widened, in some instances with an increase of value. I may mention only a few.

One of the most important widened from 8 ft. at the surface, and with an $8 to $10 ore, to 25 ft., and over $20 in 600 ft. depth, and is still widening.

Another has some ore shoots in the 300 ft. level that assay over $20, and have a width of about 20 ft. There was no sign of these at the surface, where only a small vein, although persistent in strike, was encountered.

I may mention also one of the low grade deposits, being of immense size and having a horizontal extent of over two and three-quarter miles, and a width from 150 ft. at both ends to over 400 ft. at the centre, assaying as far as ascertained in the neighborhood of from $3.50 to $4.00 on the average.

I could cite a number more of these low grade ore bodies that exist here, which are mineralized zones of a sheared granite along faults, and to which we can attribute a depth equal to that of the granite.

Uncalled for Criticism.

The reason that most these deposits are not under full exploitation at the present time is partly owing to such careless and unfavorable criticisms by persons who know absolutely nothing about them, but use, like Mr. Rickard, "hearsays" to prove a hypothesis which is absolutely indefensible.

The illustrations and similes used by Mr. Rickard for proving his point may be entertaining, but must have been absolutely unconvincing to the audience which he was addressing; proof of which is the discussion on his paper. It is difficult to understand why a man of Mr. Rickard's calibre succumbed in a weak moment to the temptation of bringing this subject before the Institute. Did he wish to show his sympathy and to prove that he has an ever vigilant eye for the dear, poor, stock-buying public? Vain attempt, the stock buyer is usually shrewd enough and keen-eyed enough not to be humbugged; he sees, as well as others, that there are many dividend paying mines in the world, and that, consequently, mining must be as legitimate a business as any other one. It is difficult enough to convince mining companies that in order to assure success to a mining enterprise, money is necessary. Why then block the way to success?

Preaching ethics to a whole industry or profession is very laudable, that is, if I have a cause or base for my sermon; but "fighting a cyclone with windmill wings" is a peculiar undertaking.

Mr. Rickard should know that flamboyant prospectuses or highly colored reports have the sign of failure on their forehead, and are therefore not to be taken seriously. Mines are rarely started nowadays by small capitalists; usually large mining companies or exploration companies are interesting themselves in the developing and exploitation of ore deposits, and these companies are well supplied with good, responsible engineers. Why should it be necessary to warn them to beware of "make believes" or "reckless optimism," and what else not?

Large Jaw Crushers.

Quarrying costs may sometimes be lowered by reducing the powder used and breaking down the rock and ore in large pieces. Heretofore, the primary crushers used in crushing plants have been of the smaller sizes, with the result that even after the rock has been blasted down, it is necessary to use a great deal of powder and dynamite to break up the pieces which are too big to feed into the crusher jaws.

The Traylor Engineering and Manufacturing Co., was one of the first to see the great field for the large primary crushers. They originally furnished to the H. S. Kerbaugh Co., at Valhalla, N. Y., one of their mammoth jaw crushers, with a jaw opening 60×84 in. which allowed of quarrying the stone in large pieces and also eliminated, to a great extent, all bulldozing, as any rock which could be picked up by a six-yard steam shovel could be fed into the jaw opening. The Kerbaugh crusher is used in connection with the crushing of rock for the building of the Kensico dam, which is a part of the $200,000,000 water supply system being installed by the city of New York. It further had a great deal to do in establishing the world's record by the Kerbaugh company when they placed in the dam, in 25 working days, 8-hr. shifts 83,000 yds of concrete, which is greater than any previous record made in any concrete operation.

Since the building of this first crusher, there has also been built a machine for the use of the H. W. Johns-Manville Co., which is fitted with an opening 60×84 in. and will be used in crushing the asbestos rock at the asbestos mines of this company in Canada. Even these crushers were not large enough so that the Traylor company is now building for the Rockland Lake Trap Rock Co. a crusher with jaw opening 66×86 in. and will be used for crushing the hardest known trap rock. This last machine will be installed just outside of New York City, and will weigh over 520,000 pounds. The notable features in the manufacture of these large crushers is the fact that practically the whole machine is constructed of cast steel throuhout, thoroughly annealed, so as to eliminate all internal strains.

Some Dimensions.

To give a better idea of the mammoth size of this machine, the machine is approximately 26 ft. long, 18 ft. high and 20 ft. wide; the crushing plates are made of manganese steel, as also the cheek plates and toggle seats. The pitman is of extra heavy construction made of cast steel, of the box section type and fitted with internal ribs and with a removable cap so as to facilitate handling. The pitman is also fitted with removable bushings, babbitted and water-cooled. Bushings greatly facilitate the rebabbitting of the eccentric or pitman and eliminates the necessity of shutting down the crusher for two or three days, which would be the case if the babbitt was poured in place in the pitman. Large crushers of this kind usually have a set of spare bushings, thoroughly babbitted, which allows of the quicker babbitting of this the essential part of the machine.

The bearings on the side frames are also fitted with removable bushings, water cooled and babbitted. This also allows of the quick rebabbitting of the bearings. Under normal operating the babbitt should not be touched in a whole year's operation; in fact, in the large crushers which are running the babbitt is not touched except when the plant is shut down for two weeks in the winter time for over-hauling, when the bushings are rebabbitted.

The water cooling features on these large crushers make it possible to run the crushers continuously without heating the bearings; the lubricating expense is also greatly reduced, for the reason that but about one-third of the lubricant necessary under ordinary conditions is used with water cooled bearings. This water cooling device has worked so satisfactorily on these large crushers that the Traylor company have adopted this design for all of their jaw crushers, and the smallest fitted with openings 7×70 in. up to the largest are furnished with the water cooled pitman and main bearings.

Capacity.

In addition to the saving in quarrying cost owing to the large openings on these large crushers, the machines have an enormous capacity with the result that the cost of crushing is also reduced. The crushers for the Rockland Lake Trap Rock company will have a capacity of 400 tons per hour, crushing down to about 10 in. and will use from 180 to 240 H. P., this estimated horse power being based on actual operating conditions of the other large crushers in use at the Kerbaugh plant.

As an indication of the strength of these machines, while the Kerbaugh crusher at Valhalla was stopped, through some oversight ten tons of rock was dumped into the machine. It was absolutely prohibitive to dig out all of this stone so they put on the power and there was enough momentum in the crusher and also power in the motor to start the crusher up and clean itself, without having to dig out a single piece

of stone. At another time the crusher was fed with ten tons of rock and as the car was dumped the power went off. There was enough momentum in the fly wheels to operate the crusher until all of the rock that was dumped into the hopper had been crushed.

The box-section type of crusher was built for the Kerbaugh company, while the ribbed section was supplied to the H. W. Johns-Manville company. The Johns-Manville crusher has a large band wheel, 16 ft. diameter and will receive the belt power direct form an electric motor. Tre Rockland Lake crusher will be driven direct from a countershaft and the main pulley will be 12 ft. diameter and 44 in. wide.

Market Day at Temascaltepec, State of Mexico.

Flotation Processes.

Flotation as a means for concentration is at present receiving much attention. Many companies and individuals are experimenting with one form or another of the principle involved; but very little has been written or published about it. The details have been carefully concealed, and even the results of experiments have been destroyed and suppressed. This is probably due to the fact that the whole matter of flotation is still involved in a tangle of litigation the end of which is not in sight. The following notes by John P. M. Laughlin, which appeared in the Salt Lake Mining Review, are timely:—

The process of concentrating ores by flotation is about thirty years old. The first patent granted for flotation process was issued to Hezekiah Bradford in the United States on June 22, 1885. No commercial tests of this invention have ever been attempted. On August 29th, 1885, the United States granted to Carrie J. Everson of Denver, Colorado, a patent for separating sulphides in ores from refuse by oil flotation. This scheme was first tried at Baker City, Oregon, in 1889. The test runs at Baker City and Denver, made use of oil for sulphides, as discovered by William Haynes in 1860; also flotation, discovered by Bradford. The Everson process went further than all preceding inventions, by adding a small quantity of acid to the pulp, and, by agitating the whole mass the recovery was greatly increased, through the action of oil and acid. The sulphides floated to the surface as a scum, while the refuse settled to the bottom of the tank. The oil consumption varied from 5 per cent to 20 per cent and that of acid about 1 per cent.

The Everson process as operated at Baker City and Denver was a complete commercial failure, through what now appears to have been an entire lack of mechanical ability.

For the next five or six years there was no further attempt made to promote flotation commercially. In 1895 a small plant was erected at the Glasdir mine in Wales. The mill had many trials and was finally closed down in 1896. In the fall of 1898, through the invention of Francis Elmore, the mill was remodeled and started upon what can be said as the first successful commercial run of any "oil" flotation plant in the world.

The Elmore Process.

The Elmore process was a success from the start, and was tried at many mines. The old Boston Consolidated Co., and the Mammoth Mining Co., in Utah, tried the process, as also did the Le Roi mine in British Columbia, and several mines in Sweden, Austria, Norway and England.

Briefly, the original Elmore process, as patented in England in 1898, depended upon recovery, mainly by gentle agitation. The ore was mixed with several times its weight in water, and an equal, or possibly

several times its weight in oil, in a revolving cylinder or drum, which was operated at a very slow speed. This was intented to thoroughly mix the mass without destroying the minute particles of oil, which were added with the ore. In 1905 the process became known as the Elmore "Vacuum" process, patents for which were granted in England in 1904.

Recovery in the vacuum process was secured by the addition of a small amount of oil, and the liberation of air into the pulp in a fine state of subdivision. The injection of air was made possible by creating a vacuum. This vacuum was caused by a small vacuum pump, the pipe from which enters the top of the vacuum machine. The air is slightly heated and when released, attaches itself to the oiled mineral particles, causing them to raise to the surface of the tanks or vacuum machine. The tailings are drawn off from the bottom of the vacuum machine through pipes that are water-sealed at their discharge end. The ore and oil is fed into a cylinder having rotating arms or beaters, its entire length. The revolving of these arms or beaters produces a pulp of even mixture. From the mixing cylinder the pulp is drawn up to the vacuum machine or separating chamber, where concentrate and tailing are separated.

The process is well adapted to treat ores that are almost impossible to concentrate by other methods. Chalcopirite is easily separated from magnetite and spathic iron refuse, and copper sulphides from oxide of tin. Cinnabar and iron pyrite are readily concentrated.

The vacuum process has been installed at the Dolcoath mine in Cornwall, and the Ramsley mine in Devonshire, England; the Edmundian Copper mine in South Africa, British Broken Hill Proprietary mines in Australia, the Caucasus copper mine in Russia; also in Sweden, Norway, New South Wales and in Mexico.

The mystery that has surrounded the flotation process has had much to do with its many failures. Literature regarding the subject is less than ten years old. Detail of machinery and methods of operations, leaving out the question of costs, by companies owning the different patented processes, have invariably been guarded as state secrets, which has resulted in much misinformation being published. The only creditable work ever published, covering the field of flotation, worthy of mention, is "Concentrating Ores By Flotation," by Theodore J. Hover, former general manager and consulting chief engineer of the Minerals Separation Co.

The Hyde Flotation Process.

On April 2nd, 1912, James M. Hyde was granted a United States patent on an apparatus and flotation process where the making of high-grade concentrates and very high recovery could be secured at the same time. The process was tried out at Basin, Montana, in 1911 and 1912, on Butte & Superior lead zinc ores. The tests were so eminently successful that the Butte & Superior erected a 1,000-ton mill at Butte, Montana, in accordance with Mr. Hyde's ideas and designs. This plant consists of the necessary crushers, jigs, hydraulic clasifiers, Wilfley tables and a slime plant for oil flotation. The ore is first crushed and then delivered to rolls which reduce it to 6-mesh. After jigging the tailings are reground to 40-mesh. The tailings from fine jigs are ground to pass through 100-mesh, and finally treated by oil flotation. The pulp is thickened to three parts water and one part ore, and is mixed with a small quantity of oil and sulphuric acid, and then agitated. Recoveries as high as 97.2 per cent have resulted from these operations.

The Minerals Separation Co., brought suit in the United States District Court, District of Montana, against James M. Hyde, for infringement of their patents in the process of oil flotation then in use by the Butte & Superior Co. In August, 1913, decision was handed down by Judge Bourguin favorable to the Minerals Separation Co. The case was immediately appealed by Mr. Hyde to the United States Court of Appeals for the Ninth Circuit in San Francisco. In May, 1914, Circuit Judge Gilbert reversed the verdict of the United States District Court of Montana, whereupon the Minerals Separation Co., further appealed to the United States Supreme Court at Washington.

Minerals Separation Co.

The Minerals Separation Co., own or control the following processes: Sulman, Pecard, Ballot, Froment, Gattermole, Higgins, Chapman, Lavers, Greenway, Nutter and Hoover. The company licenses the use of their processes and machines invented by the above named parties and others. In brief, the process, as used in the Broken Hill district of Australia, is typical of installations made at a number of other mines.

Character of ores, amount of slimes, etc., require special treatment, therefore the successful operation of a process at one mine may become a complete failure in another location. At Broken Hill the ore is lead-zinc with an average assay of about 5 per cent lead, 17 per cent zinc and 7 ounces of silver to the long ton. The ore is crushed to 40-mesh and then dewatered to form a pulp, by adding three of water to one of ore. About 2 lb. of oil and 10 lb., of suphuric acid were originally used, to one ton of ore. Live steam is used to raise the temperature of pulp to 70 deg. centigrade. The agitating is accomplished by beaters revolving at a very high speed. The pulp flows through three different compartments and in each is violently agitated. The sulphides float off from the last compartment, or tank, through launders to the bins. The refuse does not float, and is drawn off through the bottom of the receiving tank.

The Minerals Separation Co. has made many improvements during the past few years, in process and machinery. One of the most noticeable of these being the use of eucalyptus oil instead of the heavier mineral oils, which are partly incapable of being dissolved. This change resulted in a very much lower oil consumtion, also in being able to retreat concentrates direct from the tables. Formerly, where mineral oils were used, it was necessary to burn or roast the concentrates before retreatment could be made, as the oil made the sulphides gummy and almost impossible of separation by gravity.

It is reported the Minerals Separation Co. has plants now in use, as follows; Zinc Corporation Co., 1000 tons plants Kyole Copper mines, 60 tons; Junction North mine, 600 tons; Silver Peak mine, 80 tons; Wallaroo and Moonta mine, 400 tons; Etheridge mine, 80 tons; Great Fitzroy mine, 250 tons; Pennacles, 160 tons; Great Cobar, 400 tons; Chillagoe, 200 tons; Braden Copper, 1,200 tons; Saxberget, 150 tons, and Timber Butte, 400 tons.

Macquisten Process.

The Federal Mining & Smelting Co. in 1911, installed the Macquisten process at its Morning mine, at Mullen, Idaho. The plant had a daily capacity of about 150 tons. This process was also installed in 1906, at Golconda, Nevada, by the Adelaide Star Mines, to treat about 100 tons per day.

The process and machinery, as invented by. A. P. Macquisten, consists of a tube so designed as to bring the sulphide particles in the ore to the top of the water

in such a manner that their flotation through the force of surface tension and the inherent quality of the sulphides to resist wetting, is assured. At Golconda the plant consists of 100 tubes, each 18 in. diameter and 6 ft. long arranged side by side in four tiers. More than one-half of the tubes are immersed in water, and ore is carried through by endless screws, passing out of tubes at surface, into settling tanks below. Concentrates not caught in the first tier of tubes pass into the next set, and so on, the process being completed in the third set. It is stated the process gave good satisfaction in extraction from all sulphide ores, and was especially applicable to sulphides where the gangue is of nearly the same specific gravity as the mineral.

Adelaide mine ores assay from 2.7 per cent to 3.2 per cent copper. The ore runs about $9.40 per ton in value. The veins carry some native silver and are of medium grade auriferous and argentiferous copper, carrying chalcopyrite with gangue of garnetiferous limestone. The plant was closed down in December, 1910.

Sanders Process.

The Sanders process, as invented by W. M. Sanders in February, 1905, and March, 1907, and installed at Marion, Kentucky, and Straight Creek, Tennessee, by the Tennessee Zinc Co., is quite different from all other flotation process, in that no acid is used in the bath, the latter being, on the contrary, basic, consisting of a very dilute solution of aluminium sulphate. Instead of using deep tanks, as in the case of acid flotation (wherein the depth of the tank has been found to be of great importance) the basic flotation process is performed in very shallow pans, in which mechanical stirrers are operated. The tank is usually round with a feeding hopper leading below the surface of the liquid. A solution inlet pipe is placed either in the tank, or in the feeding hopper, depending upon the ore to be treated. A vertical shaft in the center of the tank rotates an agitator, the blades of which are arranged to impart a whirling motion to the solution. This whirling motion is intended to assist in raising the valuable mineral particles to the center of the tank, and to cause a slight cavitation at the center of the surface, which causes the particles which have been elevated to pass at once to the overflow pipe. The tailing is discharged through a pipe in the center of the bottom tank. A steam pipe is used in the bottom of the tank to keep the solution at an even temperature.

This process was also intalled at the Kelly mine, at Magdalena, New Mexico, a 100-ton plant being erected.

Practice at Mullen.

The latest successful addition to the oil flotation process is that installed early in 1914 at Mullen, Idaho, for the National Copper Co., being the invention of J. M. Callow, of Salt Lake City. The plant has the necessary crushing and grinding machinery and deliveres all materials from 60-mesh, in two equal streams, to two Dorr thickeners. The pulp is thickened to approximately 1½ to 1, diluted with flotation circuit water to 4½ to 1, each Dorr tank making feed for one unit of the Callow Pneumatic flotation process. Each flotation unit consists of one mixing tank, four roughing and one cleaning cell and has a capacity of 250 tons every twenty-four hours. The mixing tanks are of the Pachuca type, mixing being accomplished by air at 20 pounds pressure; the function of these tanks being to thoroughly mix the oil and pulp previous to sending the pulp to the separating cell. Each mixing tank is equipped with an adjustable splitter cutting out the proportion of the agitated pulp as desired; the oiled pulp flowing to a revolving distributor feeding four flotation roughing cells.

Each cell is divided into eight air compartments; the bottom of the cells have a slope of three inches to one foot. The mineral-bearing froth is formed by admitting air at 7 lb. pressure into the air compartments, from which it is atomized by passing through four thicknesses of heavy twilled canvas. The air required for the eight roughing and two cleaning cells is furnished by a blower running at 200 r. p. m. The froth from the roughing cells overflows into a catch launder on both sides the entire length of the cell; an air lift elevates the rough concentrates to the two cleaning cells on the same floor. These are the same type as the roughing cells, and make clean concentrates and middlings which are pumped by a centrifugal pump to the original mixing tanks. The correct amount of oil for the entire flotation process is fed into these middlings by a feed pump as the stream is split into each of the mixing tanks. The flotation tailings from the roughing cell flow to two Dorr thickeners, the overflow from which is returned to the flotation circuit, the underflow going to waste.

The consumption of oils is from 0.2 to 0.3 pounds per ton of ore. The flotation feed averages 0.8 per cent Cu, flotation concentrates 16 per cent Cu. flotation tailings 0.17 per cent Cu. The flotation concentrates, together with the concentrates from the tables, flow to an 8-foot Callow tank, the 1 to 1 spigot product of which flows to a tank fitted with an AZ agitator. The concentrates are collected in this tank; on one shift the agitator is run to keep the material of even consistency, when the concentrates are dewatered in a Kelly press, in which the moisture is reduced to 12 per cent; the moisture in the press cakes is further reduced to 6 per cent by steam drying. From the dryer floor the concentrates go direct to railroad cars.

The ratio of concentration is approximately 16 to 1, the screen analysis of the concentrates being as follows; passing 35 mesh, but retained on 48-mesh, 2 per cent; retained on 65-mesh, 4.8 per cent; retained on 100-mesh, 8.8 per cent; retained on 150-mesh, 24 per cent; retained on 200-mesh, 12 per cent, and passing through 200-mesh, 48.4 per cent. The total extraction of copper and silver (the ratio being approximately 3 ounces of silver to 1 per cent of copper) is 85 per cent, of which 30 per cent is obtained by the tables and 55 per cent by flotation.

The ore treated by the above process is described by Fred T. Green, consulting engineer to the National Copper Co., as a comparatively clean, hard, white-to-gray quartzite, in which various sulphide minerals are more or less uniformly disseminated. These sulphide minerals are chalcopyrite, chalcocite, bornite and pyrite; the proportions of the minerals being chalcopyrite, 3.48 per cent; chalcocite and bornite, 0.50 per cent; pyrite, 3.51 per cent; silica, 91.10 per cent; lime, 1.60 per cent. The ore is extremely hard, close-grained and crushes in wedge-shaped pieces causing much wear to the machinery.

This process is also being used, in large experimental units, by the Inspiration Consolidated Copper Co., the Miami Copper Co., the Anaconda Copper Mining Co., the Magma Copper Mining Co., and the Daly-Judge Mining Co.

Future Prospects.

The future of oil flotation is exceptionally bright; the field is wide for the recovery of zinc sulphides from lead milling, and in separating copper sulphides from silicious refuse. It is already in commercial use to the extent that the total recoveries to date are about 1,250,000 tons of spelter; 307,000 tons of lead;

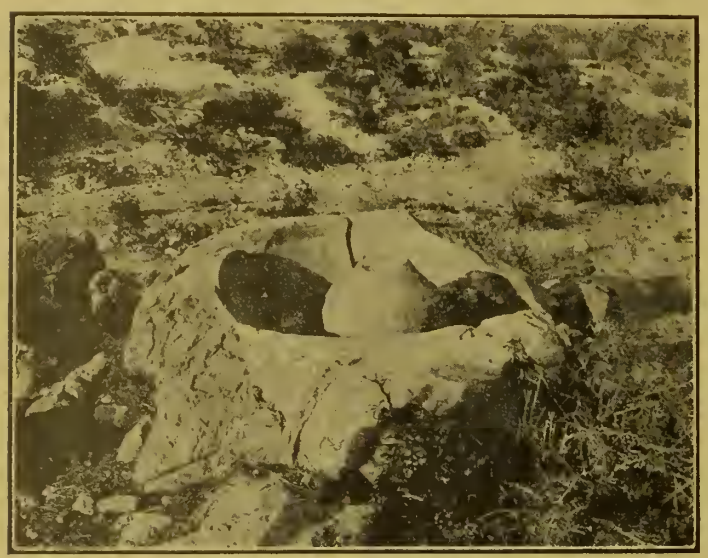
24,500,000 ounces silver, and 10,000 tons of copper.

The process has developed a successful method of recovering valuable metals from low grade ores. The progress made by experiments and tests as noted, from time to time during the past year, by the various companies throughout the country, clearly evidences the fact that flotation is the coming ore separator.

The usual flotation plant requires exacting operation; therefore special men must be employed for this particular class of work, and, in order to attain a high efficiency in recovery at low operating costs, very careful watch must be kept to avoid waste of acids and oils; hence the operating costs, in-so-far as labor is concerned, is necessarily high.

Arrastre Mining.

An "arrastre" is an arrangement as symbolic of the patience of the Mexican native as can well be imagined. Where or how it originated may be left to the archeologist, but it is a survival that has endured by reason of its own fitness. The "arrastre" is, briefly, an arrangement by which ore can be ground to a pulp beneath dragging rocks suspended from a horse-power, or, occasionally from a water-power device. In building it a firm rock foundation is secured as the surface against which the ore is crushed. A framework is erected to hold the upright pivot timber, around which plods the patient horse that furnishes motive power for the mill. The timber is shod with an iron point at the bottom, where it stands in the middle of the grinding cup. The horse is harnessed to a sweep projecting at right angles from this pivot, while to other sweeps nearer to the ground are fastened by ropes the boulders which, in their rotation, pulverize the rock. Under the compulsion of a little Indian or a superannuated grandsire, the horse marches in a weary circle round and 'round dragging two or perhaps four substantial boulders, which in the course of their abrasion gradually wear the rock foundation into a cup of remarkable symmetry, having at its center a knob upon which rests the pivot shaft. The cup is usually from six to eight feet in diameter. Old "arrastres" may be found anywhere along the water courses of gold-bearing districts, worn, some of them, to a depth of two feet or more in the hardgrained trap-rock or granite.



Old Spanish Arrastre hollowed out of the solid rock.

Except for the grinding of bonanza ore, the "arrastre" process is a discouraging one. According to the hardness of the rock, from 200 to 300 pounds of ore can be ground daily in a horse-power "arrastre." After being taken from the ground the ore is pounded as finely as may be by hand before being put in the cup. The cup is filled with water and when the grinding has been well begun quicksilver is added.

There is a knack about putting in the quicksilver. An ounce or two of the liquid metal (or more if the rock is rich) is poured into the hollow of a folded handkerchief, a moist buckskin or chamois and through this screen the mercury is sprayed over the surface of the "arrastre" cup by squeezing. As the grinding continues the ore is pulverized thoroughly, liberating the gold, which is taken up by the process of amalgamation. Later, being washed out and saved in a gold pan, the surplus mercury is squeezed out of the amalgam and the gold in turn is removed by heating.

Osmiridium.

This rare and valuable admixture of the metals osmium and iridium in varying proportions is remarkable for its high specific gravity ranging from 19.3 to 21.12 and its hardness ranging from 6 to 7 of the scale or as hard as quartz. It is thus the heaviest and hardest metallic mineral. Besides the two principal constituents there are generally present rhodium, platinum, ruthenium and a little copper and iron. In colour this metal is usually tin white to steel grey. As found in Tasmania it ranges from minute particles that might be termed dust up to nuggets of 2 oz. in weight. The grains are quite free from gangue. Many nuggets of over 1 oz. have found during the past year, and these are believed to be the largest yet discovered anywhere. Very commonly the grains are angular, and they frequently show brillant cleavage planes.

Lime exhibits some peculiar chemical reactions. It consists of 5 parts of calcium and 2 parts of oxygen, having the formula CaO. Owing to its chemical activity, it is not found native, but mostly as the carbonate $CaCO_3$. If this be heated, the following reaction takes place:

$$CaCO_3 = CaO + CO_2$$

If the lime produced is exposed to the air, it absorbs moisture, forming calcium hydroxide. This absorbs carbon dioxide from the air, resulting in calcium carbonate and water. Therefore, if exposed to the air, lime will gradually revert to a substance having the same chemical composition as that from which it was derived. Reactions are as follows:

$$CaO + H_2O = Ca(OH)_2$$

$$Ca(OH)_3 + CO_2 = CaCO_3 + H_2O$$

These reactions form the basis for manufacture of lime products and its various uses. The chemical uses are numerous in the agricultural, bleaching, caustic alkali, chemical gas, glass, grain milling, oil, fat and soap, ore treatment, paint and varnish, paper, preserving, sanitation, smelting, sugar, tanning, and water softening and purifying industries.

A decree has been issued by the Government of Venezuela providing that no concession granted by the executive shall be valid until it has been approved by Congress, and work must be postponed until that approval has been obtained.

Alamaloya, Chinuahua, Mexico.

Permanent and Water-Tight Shaft Construction in Europe and the United States.

Timbered shafts are comparatively cheap, especially where timber is as abundant as it has been in many of the mining regions of the United States, and other methods of shaft construction are practically unknown in that country. In Europe, and Africa, under different conditions, construction of a more premanent character is found economical. In some cases brick is used as a shaft lining, and when the ground is very wet, and it is cheaper to exclude the water than to pump it out, cast iron plates, sometimes two and one-half inches thick, are employed. Some of the recent shaft construction in America is noted in a paper read before the Engineers' Club of Philadelphia by Francis Donaldson. The paper is published in the October number of the club's proceedings. After describing European practice in some detail, Mr. Donaldson continues in part as follows:—

Brick or cast iron linings wíll not wear out, are safe against fire, and in a long-lived mine are cheaper in the end than less permanent linings. On the other hand they call for a circular shaft, and in a shaft with several compartments rectangular construction is much more economical and includes less waste space than any other. In Europe the development has been largely due to the geological conditions. The Europeans have been forced toward their methods by the fact that the coal and the minerals are all deep down; they have had to go down through great depths of marl and limestone. Ninety per cent. of the total footage of shafts in this country is in solid rock, and our problem is to meet the European requirements of safety, permanece and the exclusión of water without going to the great expense that they are put to in lining.

In pursuance of this idea a number of mining companies in this country have sunk shafts and lined them with concrete. The United States Coke and Coal Company were the pioneers, and they sunk two elliptical shafts in West Virginia about 200 feet deep and lined them with concrete. About three months after the mine started operations there was an explosion which wrecked the mine and killed eight or ten people, but the shafts were not injured in any way, and the operation of the cages was not stopped for an hour. They were able to go right ahead and proceed with their work of rescue and the rehabilitation of the mine itself.

It is only lately that the European requirement for the exclusion of water has been met, and that has been done on the Catskill Aqueduct. The condition has been met by cement grouting. The T. A. Gillespie Company had a contarct for the Rondout Siphon, which was a deep circular pressure tunnel under the Rondout Valley. The tunnel was about five miles long, and it was expected that they would meet considerable water. They did not, however, except in one shaft which was put down in a fault between limestone and conglomerate; great quantities of water were encountered here. This shaft was sub-let to a Pennsylvania contractor; he struck about 1,500 gallons of water per minute, put in all the pumps he could get, and could not do anything with it. The shaft had reached a depth of 350 feet when it stuck. There had been a lot of water coming in on the the shaft—a rectangular construction shaft, by the way, lined with timber—and when the sinkers struck two or three more fissures in the bottom and got still more water it was the last straw, and it broke the back of the pumps. Mr. John P. Hogan, a division engineer of the board of water supply, then suggested that cementation be tried, and it was tried there for the first time in this country. The shaft was full of water, so they put in a platform as low as they could, installed a diamond drill, and drilled six 90-foot holes in the bottom of the shaft. They pumped them full of cement grout, forcing it through the diamond drill casings. Before they went much further they encountered another leak of about 750 gallons a minute; as they drilled the bottom the water poured in through the machine drill holes they were going to shoot. So they simply plugged up those holes, then removed the plugs one at a time, drove in pipes connected to a grouting machine, pumped grout into the holes and the water off that way. By that means they were able to reduce the flow until they could put in a permanent pump station and handle the water.

The question of a water-tight lining brings up the shape of the shaft. The shaft with the maximum area and the minimum lining is of course circular, and this is by far the cheapest shaft to sink. That was brought out on the aqueduct. All the construction shafts at first were made rectangular and lined with timbers, while the waterway shafts were made circular. On the Rondout Siphon shafts we started out with the idea

that the rectangular shafts would be easier than the circular, but it was the other way. When we started the first circular shaft we did not do much the first month. The last month we made 138 feet. The next siphon we moved to we had the same gang, and they knew how, and jumped the progerss up to 170 feet in one month in shale. The same gang then moved across the Hudson River to a granite shaft, and we made 183 feet, which is the American record.

The way it was is this: The drilling is all done on one shift. Enough drills are put into the shaft, so that all the holes in the round can be drilled and the sump loaded and shot in eight hours. The other two shifts clean out the shaft and get it ready for the drilling shift the next morning. We drilled 33 holes to a round. The same method is used in South Africa on rectangular shafts, but in this country it has not been successful in rectangular shafts. I personally have tried it in four shafts, and it would not work. However, in circular shafts we tried it and made it work. I mentioned the rectangular construction shafts being slower to sink than the circular. In South Africa they hold the world's record for sinking, and the shafts there are rectangular. In this country most rectangular shafts are about 12 feet by 26 feet, and about ten to twelve men are carried on a shift. There will be two or there drill runners, three helpers, and about six muckers. In South Africa they use 35 to 40 men on a shift in a shaft of the same size. I was talking to a man from South Africa who had been engaged on some of this sort of work out there, and I asked him how he could get so many men in. He said they use Kaffir labour. These Kaffirs wear no clothing to speak of, and the temperature gets up to a great height with thirty or forty men all bunched together; they sweat, and their greasy bodies just slide past each other without any trouble. He said that the smell down there is so strong that when a little bit of rock is dislodged it just shoots right up out of the top of the shaft of its own accord.

Wherever the entire area of a circular shaft can be used, as for ventilation, a circular shape is best. Where this is not practicable, as in a hoist shaft with several compartments, the best plan is to cut the ends off the ellipse adopted by the U. S. Coal and Coke Company and make a compromise between an ellipse and a rectangular out of our circular arcs. In dry or moderately dry rock the concrete lining need not be over 15 inches to 18 inches thick, but in wet and seamy rock it must be thick enough to resist the hydrostatic pressure after the shaft is lined. In New York City lately the contractors have been putting in as high as 25 to 30 feet of concrete in a day in a 14-foot circular shaft, and in six days, including getting started, putting the forms in and taking them out again, they will put in 100 to 120 feet. The cost of a concrete lining is greater than the cost of a timber lining by just about the cost of the cement. As a rule, concrete outside the cost of the cement can be put in for the price of the timber; you have to pay for your cement and you have a permanent lining. By a comparatively small expense and proper preparation, it is possible to make a water-tight shaft and a safe shaft with no delay; we do away with the expense and danger of handling big quantities of water from shafts while they are being sunk, and we do away with the heavy fixed expense of pumping after the mine is completed.

The Frontino & Bolivia property, Bolivia, produced $423,000 from 33,876 tons of ore during the year ended June 30, 1914. This was a small increase over the previous year. The profit was $31,700. Reserves in the Silencio mine are 16,800 tons assaying $21 per ton. A new pump is being installed on No. 13 level, and sinking is to be resumed.

Extraction of Radium from its Ores.

By S. Radcliff. *

Although a number of interesting occurrences of radioactive minerals have been noted in Australia within the last ten years, only two of these have shown any prospect of becoming of economic value. At Mt. Painter, in the Flinders Range in northern South Austraila, autunite and torbernite are found sparingly disseminated in a well-defined, ferruginous lode, and several parcels of picked ore have been shipped to Europe. Recent development work has faild to reveal any extensive ore bodies of a payable character, and no attempt has been made to treat the ore locally. The second occurrence is also in South Australia, and is situated at Radium Hill, about twelve miles south of Cutana, a siding on the Broken Hill railway. This contribution gives an account of the methods developed at the works of the Radium Hill Co., of Sydney, for the extraction of radium and uranium from the ore.

The ore, a mineral complex consisting of an intimate admixture of ilmenite, rutile, carnotite, and an unidentified uranium mineral, is dry crushed to pass a sieve of 20 holes to the lineal inch, and is then concentrated by means of magnetic separators; the magnetic fraction contains the uranium values and is forwarded to the Sydney works for treatment. The concentrates have the composition:—Lime, 0.55; lead oxide, 0.16; ferric oxide, 17.4; ferrous oxide, 16.9; manganous oxide, trace; thorium oxide, cerium oxide, lanthaum and didymium oxide, yttrium oxide, 3.27; chromium sesquioxide, 0.85; uranoso uranic oxide, 1.6; vanadic oxide, 0.86; titanium dioxide, 45.85; silica, 12.70.

Although the ore is commonly referred to as a carnotite ore, from 12 to 15 per cent. only of the total uranium is contained in the carnotite; the balance is insoluble in nitric acid. The uranium thorium ratio is as 100 is to one, and radium preparations derived from this ore should, therefore, be free from mere thorium. A specimen of bromide tested by Dr. Alexander Russell was found to owe its activity wholly to radium and its decomposition products. Assuming the radium uranium ratio to be normal, the concentrates contain one part of radium element in 214 million parts. It is obvious, if such an ore is to be treated with success commercially, that treatment on the lines adopted by Haitinger and Ulrich in working up the Austrian pitchblende residues, in which two years were devoted to the treatment of ten tons of material, is out of the question.

The Sydney Plant.

The plant now in operation in Sydney has, therefore been arranged for the treatment of ten tons of concentrates per week, the ore bodies at the mine being large enough to supply this output. The process adopted is as follows:—

As the concentrates are insoluble in acids, a fusion process is necessary to effect the initial decomposition. The concentrates are mixed with three times their weight of salt cake (acid sulphate of soda) and fused in a reverberatory furnace of sufficient capacity to take 500 kilos of concentrates and 1500 of salt cake in a single charge. Three charges can be put through in twenty-four hours.

The fused product, crushed to pass a sieve of eight holes to the linear inch, is fed, in small amounts at a time, into wooden vats fitted with agitators. Cold

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* Abstract of paper read before the Australasian meeting of the British Association for the Advancement of Science.

water is fed continuously into the vats at the bottom and an overflow is provided near the top. By suitably adjusting the conditions, it is possible to separate out on the bottoms of the vats a considerable amount of comparatively coarse material which is almost free from radium and uranium. The turbid liquid overflowing carries in suspension the radium, lead and barium as sulphates, together with a considerable amount of finely divided silica; while in solution we have the uranium rare earths, and part of the iron and acid earths contained in the ore.

The coarse residues are removed from the vats daily, re-washed to free them from any undissolved fused product, and sent to the dump.

The overflow from the dissolving vats is pumped to large lead-lined settling tanks and allowed to stand all night. The "slimes" settle completely in twelve hours, and the clear liquid is drawn off daily and treated for the recovery of the uranium. The slimes, which amount, when dried, to approximately 10 per cent, of the weight of the concentrates, are collected weekly and treated for the recovery of the radium as described below.

The further steps in the treatment process may conveniently be described under two heads:—

(a) The recovery of uranium.

(b) The recovery of the radium.

(a) Recovery of the Uranium.

The clear solution containing the uranium and much of the iron and other bases in the concentrates, together with a large amount of sodium salts, is fed into a series of vats containing a measured excess of a mixture of carbonate and bicarbonate of soda; and heated and agitated by means of steam jets. The iron, with most of the other bases present is precipitated, while the uranium goes into solution together with some of the rare earths. The bulky iron precipitate is separated partly by settlement and partly by means of vacuum filters. It is difficult to handle and cannot be washed effectually; a portion of the uranium is, therefore, unavoidably discarded along with this precipitate. The uranium solution is made just acid with sulphuric acid. heated, and the carbon dioxide expelled by a brisk current of air. The uranium is then precipitated by the addition of ammonia. The ammonium uranate is thickened somewhat in conical settling tanks and then further thickened to a pulp in a hydro extractor. This pulp is dried and dehydrated in large muffles. The dehydrated product is broken up and washed repeatedly with hot water. This treatment removes the bulk of the sodium salts, and a product is obtained which on drying contains about 75 per cent. of U_3O_8. An analysis of this, together with that of the iron precipitate, is given in the table below. Prior to analysis the iron hydroxide was twice dissolved and reprecipitated with ammonia to free it from the large amount of sodium salts present. The washed precipitate was dried, ignited and analysed.

TABLE	Uranium Product	Iron Precipitate
Insoluble matter	3.0	
Titanium dioxide		8.11
Ferric Oxide	9.41	74.65
Uranosa uranic oxide	76.6	2.7
Rare earths	1.57	7.36
Lead oxide	0.51	—
Vanadic oxide		1.2
Chromium oxide		5.81
Sodium salts	8.21	—

(b) Recovery of the Radium.

The thickened insoluble residue or slime from the settling tank is mixed with half its dry weight of strong sulphuric acid and allowed to stand for several days. It is then washed, first by decantation and then on a vacuum filter, till the washings give only a very slight precipitate with barium chloride. The acid treatment and washing reduces the bulk of the slime considerably, removing large amounts of acid earths and iron salts. The washed slime in quantities of about 200 kilos, dry weight, is then boiled in a large steel boiler under pressure with an excess of a 20 per cent. solution of sodium carbonate for two days, the solution being replaced once during the boiling. This treatment dissolves a large amount of silica, and converts much of the lead, radium, and barium sulphates to carbonates. The slime is then washed till the wash water gives no reaction for sulphates; this takes two days for each lot of 200 kilos. The washed slime is then fed into a warm dilute solution of hydrochloric acid, agitated for a couple of hours, and allowed to settle all night. The clear solution is syphoned off and the lead, barium, and radium precipitated as sulphates. After washing once by decantation, the slime is again treated as above described. Two treatments suffice to extract most of the radium, but the slime is reserved for a further treatment, if necessary. The plant as at present arranged can treat the slime from ten tons of concentrates per week. The weekly yield of crude sulphate is about 12 kilos.

During the past two years I have made a number of experiments, both in the laboratory and on the working scale, to see if the sulphates in the slime could be reduced by heating the material with carbonaceous substances, or else in a current of some reducing gas, but the results so far have not been encouraging.

The treatment of the crude sulphate is now carried out as follows, not as in the paper read by the author before the Royal Society of New South Wales last year:—The crude sulphate is dried and fused with three times its weight of caustic soda in an iron pot. The melt is poured, cooled, and digested with hot water. Most of the lead goes into solution The insoluble residue is washed till free from soluble sulphates, and then digested in a rotating boiler under a steam pressure of about 60 lbs. This converts the bulk of the sulphates of barium, radium and lead to carbonates. The carbonates are well washed on a filter and dissolved in hydrochloric acid. The solution is taken to driness to remove any colloidal silica, and the residue is taken up with water and a little HCl. In addition to barium and radium chlorides, small amounts of iron and lead chlorides, together with considerable quantities of barium, lanthanum, didymium, and thorium chlorides are present. This solution is now saturated with hydrogen chloride gas; the barium and radium are precipitated quantitatively as chlorides, almost free from the other substances present. The chlorides are filtered off, dried, dissolved in water, and purified from the small amounts of second and third group elements in the ordinary way. They are finally precipitated as carbonates by means of pure Na_2CO_3, and the carbonates dissolved in HCl. This solution is now ready for fractional crystallisation for the recovery of the radium.

The economic success of the process depends on the fact that it is possible to decompose the uranium minerals without bringing the whole ore complex into solution, and that comparatively small amounts of reagents are required to effect this. The tailings sent to the dump, amounting to about 50 per cent. of the material smelted, are almost free from radium and uranium, and appear to consist mainly of unaltered rutile. The radioactive slimes amount to about one ton from every ten tons of concentrates, and are one fifth of the weight of the tailings. As

the alpha ray activity of the slimes is thirty times that of the tailings, it appears that the slimes carry over 80 per cent. of the radium originally present in the concentrates. That is the initial fusion of the concentrates enables a great concentration of the radium to be made by mechanical means before continuing the chemical treatment.

Rare Earths.

The rare earths in the concentrates distribute themselves in the course of the iron hydroxides carrying 7.36 per cent. rare earths, the uranium product containing 1.57 per cent. and the crude sulphates. The rare earths extracted from the iron hydroxide precipitate are only very feebly radioactive. The activity does not increase with time, and is due to the presence of 0.06 per cent. of thorium oxide, with its attendant ionium. The earths extracted from the uranium product are also only very feebly active. The rare earths carried down with the crude sulphate contain a considerable proportion of the thorium in the ore, and appear also to carry most of the actinium. This is to be expected, as it is well known that actinium can be extracted from a solution by precipitating barium sulphate in it. A thorium ionium preparation worked up from the earths in the crude sulphate has an activity several hundred times as great as that of U_3O_8.

The concentration of the actinium in the crude sulphate enables its recovery to be effected readily and simply, as it is contained in the acid liquors resulting from the precipitation of the radium barium chlorides by means of hydrogen chloride. The rare earths in this solution are now regularly recovered, and it is hoped that sufficient material may be accumulated to allow of actinium preparations of a high order of purity being obtained. It may ultimately be possible to gain information as to the spectrum of actinium, and also as to the value of that most important missing constant, the atomic weight of actinium.

In conclusion, I might mention that an active polonium preparation has been worked up from some of the radio lead, and that a specimen of the lead has also been supplied to Prof. Theodore Richards, of Harvard, at his request, in order that he may make a determination of its atomic weight.

Mine Timber and Substitutes. *

Until recent years, no form of mine support has been in general use except wood which could be obtained on the hills in close proximity to the mine opening. The operators could often purchase posts delivered at prices below what it would cost to employ labor to cut the timber on their own ground, and pay the cost of transportation, which was nominal, thus making wood the cheapest material avaliable. From a practical standpoint wood may be cut to fit varying conditions in the mine without other than ordinary labor equipped with a saw or hand ax. The wood could be obtained sufficiently strong for the purpose for which it was required, and when loaded beyond its capacity it would usually give warning of its rupture by cracking noises in plenty of time to allow the workmen to escape with their tools. These conditions, however, have been passing by degrees, so that few opeartors are able to send their timbermen to the woods surrounding their mine openings for props, and no longer can they select a certain kind of wood or obtain the class of post that they formerly used except at high prices.

The problems confronting the mining man to-day in regard to the increase in the cost of mining operations due to the increasing cost of timber require considerable thought.

The mining engineer is trying to solve the timber problem in the following five ways:—

1. Reforestation.
2. Reducing loss by decay.
3. Timber economy in mines.
4. Adopting methods of mining which reduce the timber consumption for maximum recovery of coal.
5. Substitutes for wood.

Reforestation.

To appreciate what is being done in this line, I have taken some figures from the address of Henry Dinker, president of the American Forestry Association, as printed in the "American Forester," March, 1912.

The State of Pennsylvania has a State Department of Forestry and the second largest State Forest Reserve in the United States (about 1,000,000 acres), with provisions for purchase of land not exceeding $5 per acre. There are a college and an academy in Pennsylvania giving courses in forestry.

H. S. Graves, the United States Forester, gives full information of the work done by the United States Forest Service in his report of 1912.

The report states that among the private interests engaged in the practice of forestry in 1911 were ten coal companies with acreage distributed as follows:—Ohio, 34,510 acres, Indiana 100 acres; New York, 10,000 acres; and Pennsylvania, 43,308 acres; a total of 87,918 acres. Another company having both coal and railroad interests has 100,000 acres in addition to above; this has, no doubt, been increased in the last 3 years.

Reducing Loss by Decay.

The Department of Agriculture states that 45 per cent. of the timber which is taken into the mines decays, and to reduce this large precentage several methods have been adopted, the most simple being the peeling of the timber and using judgment when the timber is to be cut. Timber cut during the summer months decays more rapidly than that cut during the winter. Loblolly pine cut during the summer has been observed to show the first evidence of decay within six to eight weeks. Timber after reaching the mine has been given the brush treatment with whitewash, cheap paint, creosote, or carbolineum, with effective results. Timber has also been treated with creosote and zinc chloride at a cost of 20 and 12 per cent. increase, respectively. Several large coal-mining companies have found is necessary to install plants for the treatment of timber for use in mines. Treated timber would be in more general use if such wood could be more readily bought in the open market, thus eliminating the cost necessary for individual plants. The preserved timber could be used to advantage where permanent timbers are desired or where timber is to be left standing for one year. If treated by one of the above methods, this may be considered as the life of timber in any except the best of atmospheric conditions. This life may seem rather short, but one would seldon re-use a timber after its being in use one year underground. The timber may still look strong, but it has lost a great deal of its vitality.

I have been shown timber that has stood for twenty-five years. These appeared to be in excellent state of preservation, not a single prop had fallen, but upon careful examination it was found that a penknife could be buried to the hilt with little pressure. These props had been split from the centre of white oak trees and contained little or no sap wood. Manifestly there was

* Abstract, from a paper read at Monongahela meeting of the Coal Mining Institute of America.

no weight on these timbers, the roof being supported by the adjacent pillars.

The use of mine timber preserved with creosote or other oils has frequently been condemned on the ground that they increase the inflammability of the wood; again, in case of fire, the irritating effect of the smoke is very great. Some European experiments claim that only a few drops, when burned in a room, will make respiration impossible. However, I am advised by the superintendent of a preservation plant of one of the railroads that after treated timber has stood for two or three months, it becomes difficult to ignite.

Timber Economy in Mines.

This may be attempted (1) By the use of a portable sawmill to utilise broken or otherwise worthless timber. (2) By dressing the timber.

(1) Portable sawmills have been installed by mining companies for the purpose of sawing up broken timbers and odd lengths into caps, lagging, and even lumber. One company using a portable sawmill reported a large reduction in cost of wood. If one company makes a report of this nature, the amount of broken timber and odd length being covered up daily in the many mines of our country is a very appreciable item.

In large mines, the sawmill may be under ground, so that the timber can be cut inside the mine, thus avoiding the necessity of hauling the lumber out of the mine and then back in again.

(2) Dressing timber. Decrease in the cost of timber may be accomplished by removing the bark as soon as cut and allowing the timber to air dry, an operation that will afford the timber a better opportunity to season. add strength, and retard decay. The Department of Agriculture reports that slabbing a prop tends to increase its unit strength, probably the effect of improving its straightness; however, the freight on dressed timber is more than on undressed. Conclusive results could be obtained only by comparing materials cut in the same area. The unit strength of a round post is more than that of a split post of the same area; likewise, the unit strength of round timbers used for beams is less than when a bean is sawed to the same area but proportioned in height to breadth to give the best unit strength design.

Under favourable conditions of roof and floor, props may be made more serviceable by sharpening one end to the form of a wedge or to a point so that the prop will yield somewhat before the elastic limit has been reached. The results of some tests published by Emil Stens, in "Glückauf."

TABLE I.

	Pressure in Tons.	Compression per Cent.
1. Props fastened at upper and lower end.	15.1	.31
2. Prop with a 4-inch wedge-shaped cap on top	16.3	5.20
3. Props with 4-inch wedge on both ends..	14.1	8.70
4. Prop with 4-inch wedge-shaped cap on top and beveled at bottom; length of bevel 1-5 times the diameter	16.8	17.50
5. Same with bevel 3 times the diameter..	15.3	18.20

are in Table 1. The props consisted of straight pine 10 centimeters (3.94 inches) in diameter and 1.4 meters (or 55.12 inches) long. Five props were used for each test.

The results of these tests show that the yielding capacity of props can be increased from 3 per cent. to 18.2 per cent. without decreasing the carrying capacity of the timber. On account of the varying grain in the wood, it is always best to toe the bottom of the prop into the ground by 1 or 2 in. The best results are obtained by using a cap piece with some sap wood. This being soft, allows the prop to adjust itself so that the pressures come on it more evenly.

W. H. Hepplewhite, who was among the first to try out the pointed or tapered prop, conducted a test on props 6 ft. long and 6 in. in diameter with a 15-in. taper. At 15 tons, the prop began to broom at the bottom, and at a pressure of 34 tons the prop began to buckle in the middle. This allowed a roof depression of 15 in. without damage to the bulk of the prop, whereas a prop with square ends would have broken and become useless when the roof had come down about 2 in. The former prop could have been redrawn and reset, the latter could not. Men using axes to cut their props instead of sawing, can taper a prop within one or two minutes of the same time that is required to cut off an end.

The use of pointed props for gob timbers is worth considering where the floor is medium hard, especially in places where the roof is firm. This same effect is produced in a minor way by placing the wooden prop on a pile of soft dirt, but this does not seem so practicable since the compression at first is very rapid at low pressure and then quickly changes to a very slow rate of compression.

J. P. Houfton, president of the Institution of Mining Engineers, page 196, vol. 43 of the Transactions, gives the following interesting instance:—

He drew a comparison betwen steel and tapered props. He happened to have one mine where they were using nothing but tapered timber props, and another colliery where steel props were exclusively in use. At the former mine the cost of timber was from 6 to 7 cents per ton of coal produced, and at the mine where steel props were in use, the cost of the props—after allowing 25 per cent. for depreciation—came to a very minute fraction over 2 cents per ton. In the mine where the tapered props were used, he could not remember of a single fatal accident having occurred. Over 2,225,000 tons of coal had been brought out without a life being lost at the coal face, and that, he thought, might perhaps be attributed largely to the fact that tapered props were used.

Reduce the Timber Consumption.

The timbering problem is so closely related to mining methods that this phase must be considered sooner or later. In the room-and pillar method often no attempt is made to recover timber; with the longwall method a large part of the timber is sometimes recovered. In hydraulic filling, the first excavations are filled or partly filled with loose material, which in time acts as a roof support while the pillars are being removed. This method will support the roof and stop squeezes where all other known methods have failed. The writer has observed pillars being extracted with the use of very little timber where a squeeze heaved the bottom of the old entry up tight against the roof while the coal was being removed.

Substitutes for Wood.

I wish to call attention to what has been done in securing substitutes for timber.

Hydraulic filling has been a valuable means for recovering pillars and preventing annoying surface movements. The use of hydraulic filling is such a large topic that I shall but call it to your attention.

Another substitute for wood is hand stowing of waste materials from the mine along the main passages, in the working places.

A third substitute is the building of rock pillars

Picking Coffee, State of Vera Cruz. Courtesy Mexico View Co.

A Mexican Milk Wagon. Courtesy Mexico View Co.

Water Carriers at the Hacienda, Mexico.

Courtesy Mexico View Co.

A Wayside Restaurant in Mexico.

Courtesy Mexico View Co.

without the use of cementing material. Such a pillar when compressed about 30 per cent. has a resistance to load about equal to what the pillar will stand. A pillar of this kind is serviceable and costs about $1.25 per cu. yd. for construction.

A fourth substitute is the use of well-constructed concrete, brick, or some masonery used alone or in combination with steel or wooden beams. Supports of masonry must be considered as perfectly rigid and are used to provent the roof from bending and subsequently falling. After a weight greater than its compressive strength has been applied to a support of this kind it is of no more value.

Concrete or masonary arches and concrete or masonry walls with steel beams are gradually eliminating timber sets with lagging, as mine portals, shaft bottoms, underground stables, pump houses, and other similar places where permanent work is important. In one mine there is approximately 1 mile of concrete and brick lined entry.

A concrete or masonry wall built along the haulageway to support the cross-beams acts both as posts and lagging, and should a trip of cars become badly wrecked there is no danger of the end supports of the cross-beams becoming dislodged and allowing the roof to fall. Where concrete or brick walls for the end supports of beams are built they should be solid up to the top of the car, and pillars for the beams may be built on top of wall.

Steel sets are frequently used on the permanent haulage roads of airways as mine roof supports in place of wood. Discussion on this phase of timbering has been thoroughly covered in papers read before this institute and elsewhere by R. B. Woodworth, of the Carnegiee Steel Co., in which he keeps this important topic up to date and constantly before the attention of mining men.

The first cost of steel supports erected is usually two to three times that of wood, but the cost usually warranted by the increased life and by the expense sometimes necessary to clean up a fall and renew timbers that have failed. Another important item for consideration in this matter of cost is the reduced output caused by blocking a haulageway by unexpected failures that must be cleaned up during the day shift.

Comparative tests between steel I beams, steel rails, white oak; chesnut, and white pine, by A. W. Hess, of the Consolidation Coal Co., show that a 4-in. I beam will do the work of an 8-in. round timber.

A sixth substitute for wood in a mine is the use of steel or iron props at the face. This practice is possible only where the props can be recovered or in that portion of a mine where it is possible to recover the props before they have become overstrained to such an extent that they must be straightened, repaired, or sold for scrap. Rigid props fail upon a compression of a very small per cent.; they are used to keep the roof in place and prevent it from starting to give, as may be illustrated by referring to a tender shale above a flexible roof coal, where the prop is to hold the roof coal up against the shale; another use is to support the roof where the roof or floor as a whole are unyielding. Steel props can be made yielding by combination with wood or by allowing a part of the prop to rest in a cavity filled with peat or other loose material. The yielding steel prop is probably used in Germany more than any other country.

The steel prop giving the best design from a structural standpoint is the pipe. This has been tried in the anthracite region when great supporting power was necessary. The pipe was cut to lengths and a flange placed on both ends to increase the bearing surface. Scrap pipes from old culm lines have been used in underground stables and such places by filling the interior of the pipe with concrete. The most economical design of steel to withstand compression is the H-section beam, where the radius of gyration is more nearly equal about both axes. This design has been used in England since about 1890 and is now quite common. It has also found a market in the anthracite district to a limited extent. The chief drawback in both the pipe and H section is the inability to readily change the length to suit conditions. This has been overcome in several different ways. The screw-jack head was used in a bituminous mine of Pennslyvania about 1906. These props were made to protect a coal conveyer, but they would also be of advantage in many mines as temporary props under draw slate for protection in taking down bad roof.

Another form of adjustable prop consists of a channel bar with a T beam telescoping into the channel; the lower end of the T beam is slightly wedge-shaped. The T beam which contains horizontal slots is raised to the proper height forced against the roof by iron wedges being driven into the slots in the T beam and resting on the band on top of the channel bar. A wooden wedge is then driven in between a movable ring and the wedge-shaped end of T beam. The iron wedges through the T beam are then removed and used at the next post. An oval-shaped bolt is provided for use on the back side from the wedge, and when it is desired to remove the prop this bolt is given a one quarter turn, which turns it to the flat side loosen-in the wooden wedge and allowing the prop to collapse. The compression of the wedge allows the props to yield at a load of 15 tons, which is regulated somewhat by the kind of wood used for the wedge. This prop has found use in both Germany and Belgium.

The Mannesmann weldless steel props consist of two pipes, one telescoping into the other so that they can be adjusted to the proper height. They are held in position by a clamp which is attached on the outside of the prop in such a manner that it cannot slide down. It is claimed that the clamp can be screwed to a resisting force of 15 tons, after which time the telescoping will proceed as that weight is being applied. Good results have been obtained by using these at gate ends and to the first waste conjointly with tapered props. These props, as the ones above can be easily removed from a distance.

Bolivian Tin Smelting.

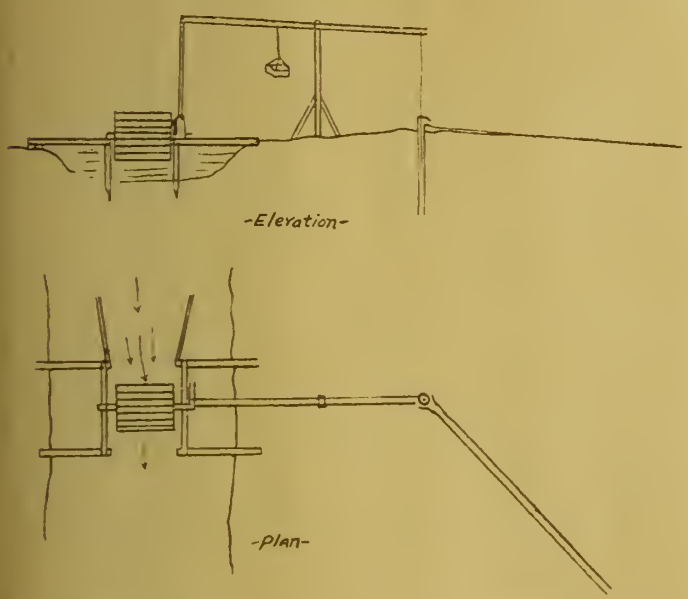
The **American Metal Market** states that the Bolivian Government has begun informal inquiries whether the United States would permit it to construct a big Government smelter near New York to smelt the Bolivian tin ore output which in the past has been smelted in Germany and England, and from which they are now entirely cut off in the former country. Asistant Secretary Sweet, of the Department of Commerce, to whom the Bolivian proposal has been presented, said both New York and Baltimore had been considered for the site of the smelter. New York had been determined upon largely because of the ability to obtain coal dust there for use in the smelting proces. Bolivia had proposed the smelter scheme, it was said, as one means of meeting the financial and economic plight of the Latin-American countries. Export duty was imposed on tin ore, and with commerce halted a source of revenue was cut off both to the Government and shipper. It was deemed more practicable to build the smelter in the United States than in Bolivia because of the difference in the price of coal and because the finished product would be nearer the market of consumption.

An Inexpensive Pump.

By Frederick W. Foote. *

Sometime ago while making a trip up Clear Creek Canon, Colorado, I noticed several pumps of an extremely simple and cheap design. They apparently performed their function (to lift a small amount of water from a well continuously) to the entire satisfaction of their owners with very little upkeep expense.

The waters of Clear Creek are made unfit for irrigation, or other purposes requiring clear water, in their lower reaches by the slimes introduced into their upper reaches by the mills at Silver Plume and Idaho Springs. For this reason the small properties operating below have to derive their water from wells. These wells are drilled on the banks of Clear Creek and a water wheel is placed over the creek. These wheels are usually made on the premises and are of the undershot type about six feet in length and diameter.



A post, to act as a fulcrum, is erected on the shore about half way between the wheel and the well. A balance beam has an eccentric connection to the water wheel on one end and is connected to the plunger of the pump on the other end. This mechanism is adjusted so that the length of stroke will be proper for the best working of the pump. A box of stones hung on the pump side of the arm and capable of being moved in or out along the arm is used to compensate for the different flows of the creek by increasing or diminishing the work necessary to be done by the wheel. A trough from the pump discharge carries the water to the required place of use.

This arrangement is shown in the following sketch.

The Latest in Chemistry and Metallurgy,

Analysis of Ores Containing Tellurium.—A modification of Gutbier's method has now been found to answer best. The original method of Gutbier gave good results, but required slow addition of the chief reagent (Hydrazine), thus taking too much time. For instance Na-HSO requires a 24 hours' standing in a warm place, the solution being warm when mixed. A freshly prepared material for the reagent is also necessary. Further, SO_2 is only effective if the acidity of the HCl solution be fully 10 per cent., and the solution kept hot. Twenty-for hours standing is necessary.

By means of a combination of SO and hydrazine, complete separation can be effected in a much shorter time. The tellurium as TeO_2 or as tellurate in HCl with approximately 10 per cent. free acid, is heated to boiling, and 15 cc. of a saturated SO_2 solution added. Boiling is continued until the precipitated tellurium settles readily.

This should not require over five minutes. Wash on o Gooch filter until all Cl is removed, then with alcohol, dry at 105 deg, and weigh.—Zeitscher f. off. Chemiker, July, 1914, Vienna.

Estimation of Magnesia in Magnesite.—The magnesite must be crushed to powder and dried by pressure between folds of filter paper. The powdered sample is then transfered to a well corked test tube. One gramme of the sample is weighed out, dissolved in 50 cc. to 100 cc. H_2O, adding HCl gradually. The solution is filtered if turbid or if anything remains undissolved, and the collected filtrate is brought into a beaker having from 300 to 400 cc. capacity of liquid. To the clear solution from 25 to 40 cc. of ammonium chloride and an excess of ammonia are added, so that the liquid smells strongly ammonical. Now, while stirring, a solution of sodium orthophosphate is cautiously added, until no further precipitation occurs.

Stirring must be continued, but withhout allowing the stirring rod to touch the sides of the beaker. The mixture is covered and set aside for twenty-four hours, the clear liquid decanted on to a filter and the pricipitate washed with H_2O to which a slight quantity of ammonia has been added. The washings are decanted on to the filter by a stream of dilute ammonia directed from a special wash bottle, care being taken to remove every trace of precipitate from the beaker, as it will be found that the latter adheres strongly to the glass wall. Ammoniacal water is squirted on to the portions adhering, rubbing same off with a glass rod, the end of which has an inch of black india-rubber stretched over it; this suffices to remove the precipitate completely. When the whole of the precipitate has been transferred to the filter, the latter is repeatedly washed with a few drops of ammoniacal water, and the filtrate tested with silver nitrate, using a subsequent addition of nitric acid.

As soon as the liquid shows no trace of phosphate or chloride of silver under this treatment, the filter is dried. When dry, the precipitate is transferred to a porcelain crucible.

The filter is carefully lifted off the funnel and burned on platinum wire, and the ash added to that in the crucible.

As it is more difficult to burn all the carbon off the filter with this precipitate, a drop of fuming nitric acid may be let fall from a small pipette, on to the ash when the crucible is very hot; in this way the ash is almost entirely consumed. The precipitate is then strongly ignited over a Mecker burner for twenty minutes, or until the residue is quite white. The crucible is cooled in a desiccator and weighed, the contents being magnesium pyrophosphate, i.e., $Mg_2 P_2 O_7$. The calculation of the percentage of MgO is based upon $Mg_2 P_2 O_7$ = 222 parts, containin 2 MgO=80 parts, thus assuming the total weight of $Mg_2 P_2 O_7$, has been 0.5281 gr., the calculation results to 0.1903 MgO.

Research in Chemical Crystallography.—Prof. Dr. Nernst has investigated the thermal conductivity of isomorphous compounds; his results show that the analogy between the heat conductivities of such substances is just as close as is observed in the property of cleavage. The three rectangular directions of maximum, minimum and an intermediate velocity of heat conduction in a crystalline medium are described as the axes of thermal conductivity; the latter not only occupy corresponding positions in isomorphous crystals, but their magnitudes are also in similar ratio to each other. The article is accompanied by tables

* University. Va.

giving the composition and cleavage of the substances investigatetd.—Journal f. prakt. Chem., 1914, page 364.

Testing of Bromine.—Bromine is rarely supplied of sufficient purity to use it without testing it for the presence of chlorine and iodine, which, with certain estimations, must be taken. Chlorine is detected by shaking a little of the bromine-reagent with three times its volume of water; the liquid is then poured into a conical glass, and the supernatant aqueous solution decanted into a test tube and shaken with an equal volume of ether; the lower or aqueous layer is then transferred, by means of a pipette, to another test-tube, and boiled until the ether dissolved is volatilised; it is then, after the addition of a few drops of diluted nitric acid, completely precipitated with silver nitrate; the precipitate is washed, by repeated decantion and subsequently dissolved, by the aid of heat in a solution of ammonium sesqui-carbonate. After cooling, the filtered solution is reduced by evaporation to a small volume, and finally over-saturated with nitric acid, when silver chloride is separated, if the bromine is contaminated with chlorine (this test depends, apparently, upon the solubility of chlorobromine in water, and the deportment of ether, which decomposes the chloro-bromine, abstracting the bromine from the aqueous solution, and leaving the chlorine as hydrochloric acid in the water, and further it depends upon the solubility of silver chloride in ammonium sesquicarbonate). (Remark by the translator). The above test may be made quantitatively, by taking a known weight of bromine which is precipitated as silver chloride, collected and weighed; calculating the amount of chlorine contained in the quantity of the latter on the basis of the fact that silver chloride contains 24.73 per cent. of chlorine.

Iodine is indicated by a purple coloration of carbon bisulphide, when this reagent is shaken with a solution of the bromine in a strong solution of sodium hydrate, which has been oversaturated with fuming nitrice acid previous to the addition of the carbon bisulphide.—Zeitsch. Chem.

Rules for Metric Conversion.

Certain approximate relations between common metric units of measurement and their English equivalents exist. Albert A. Cary presents these in **Power,** in the form of the following handy table.

Dimensions etc.	Unit Used	Converted to	Rule
Weight	Kilogram	Pounds	Multiple by 2 then add 10 per cent
Length	Meter	Feet	Add 10 per cent. then multiply by 3
Surface	Square meter	Square feet	Add two 10 per cents, then multiply by 9
Volume	Cubic meter	Cubic feet	Add three 10 per cents, then multiply by 27
Capacity	Liter	Quarts	Add one-half of 10 per cent. (or 5 per cent.)
Temperature	Centigrade	Fahrenheit	Multiply by 2; subtract 10 per cent., then add 32
Heat	Calories per kilogram	B. t. u. per pound	Multiply by 2, then subtract 10 per cent.
Heat	B. t. u. per pound	Calories per kilogram	Multiply by 0.556 (or divide by 6 and then by 3)
Pressure	Kilograms per square centimeter	Pounds per square inch	Multiply by 14.223 or divide by 0.07
Pressure	Pounds per square inch	Kilograms per square centimeter	Multiply by 0.07
Evaporation	Kilograms per square meter	Pounds per square foot	Divide by 5
Evaporation	Pounds per square foot	Kilograms per square meter	Multiply by 5
Distance	Kilometers	Miles	Multiply by 0.6 and add 5 per cent. of the product
Distance	Miles	Kilometers	Multiply by 1.6
Capacity	Cubic centimeters	Cubic inches	Divide by 16 (or by 4 twice)
Capacity	Cubic inches	Cubic centimeters	Multiply by 16

The rules are so simple as to be easily carried in the head, but for accurate results more complicated factors must be employed.

Venezuela.

Venezuela is a State in which mining interests appear to be reviving. The country has, of course, had a great past, and it is only necessary to mention the El Callao mine in the province of Bolivia to recall a property which has been one of the bonanza mines of the world. This mine closed down about twenty years ago, and, as far we know, has not been worked since. Gold mining on a small scale is carried on to-day at the Yuruari Mines, about the river of that name. The exports for last year are estimated in a recent Consular Report at 15,000 fine ozs. Of late, however, interest has turned rather in the direction of oil. Around Lake Maracaibo, in the State of Zulia, numerous groups of British and American geologists have been doing prospecting and boring work, both for oil and coal. In this way tracts, hitherto occupied exclusively by the Indians, are being examined, and the prospects are stated to be favourable.

Gun-cotton, used in torpedeos, is made by treating cotton from spining machines (cotton waste) with a mixture of 1 part nitric acid and 3 parts by weight of sulphuric acid. The contact is up to 12 hours, considerable heat being generated during the reaction, necessitating the vessels being surrounded with water. Excess liquor is removed from the treated material by a centrifugal extractor. The cotton is then washed in water suddenly to remove the remainder of the acid, further drained and washed, and reduced to pulp in a rag engine as used in paper mills. It is again washed in warm water for about 48 hours, a little lime, soda, or ammonia being added to neutralize any trace of acid. The pulp is finally molded as desired, it containing a little moisture to avoid explosion during cutting, etc. When gun-cotton is enclosed in a strong case, such as a torpedo, and exploded by contact, rapid decomposition takes place, and Berthelot has estimated that the pressure produced by the detonation of the explosive, compresed to a density of 1.1, is 24.000 atmospheres, or say 160 tons per square inch, only half the pressure assigned be him to the detonation of mercuric fulminate.

Next to wolframite, scheelite ($CaWO_4$) is the chief ore of tungsten, and is a calcium, or tungstate of line. When pure it consists of 80.6% tungsten trioxide and 19.4% lime. It usually carries also a trace of molybdic acid combined with the tungsten. In appearence it is white and translucent, and sometimes it has a faint yellowish or brownish tinge, specimens having been found with this coloring quite pronounced. In hardness it would be between 4.5 to 5, its specifiec gravity is 6, and it has a tendency to cleave into an octahedral form. In appearance it closely resembles calcite or orthoclase; it is, however, far more difficult to cleave. and is more than twice the weight, bulk for bulk, of either of these minerals. It is often confused with barite or heavy spar. Generally speaking, its high density is the most characteristic property it possesses, as it is heavier than any of the minerals that it resembles.

Gold output of the Ouro Preto mine, Brazil, in September was $41.200 from 6050 tons of ore.

The principal use for tungsten is in the manufacture of high-speed steel, a steel which holds its temper at much higher temperatures than will carbon steel.

PATIO

Among famous ore deposits, the Comstock lode was essentially a fissure deposit reaching to a depth of 3500 ft. and payable to a little more than 2000 ft. in Tertiary strata. The Pzribram lode in Lower Silurian strata was worked to a depth of 3640 ft. The Bendigo lodes are also in Silurian rock. Both the Bendigo and Pzribram lodes are fissure deposits. The Lake Superior copper deposits are bedded deposits occurring in the Paleozoic formation, and have been followed to a vertical depth of 5368 ft. The Rand deposits are also of the bedded variety occurring in Paleozoic strata, and have been followed down 4780 ft. The lodes in the Kalor goldfield are fissure deposits occurring as Archean schists.

The geologically old gold veins are represented by those of the Kolar, Bendigo, Minas Prietas and other districts. They usually occur in old schistose rocks and in association with deep-seated eruptives. The quartz is coarsely crystalline and often occur in lenses or pleats. Gold is the important mineral and is generally very coarse, one sulphide usually predominating. The presence of graphite is sometimes reported. The old veins frequently persist to great depths.

It has been found in copper smelting that one square foot of area at the tuyere line of a blast furnace will smelt from four to seven tons of charge per day; about four tons for small circular furnaces., five tons for small rectangular furnaces, six tons for the larger rectangular furnaces and up to seven tons for the extremely long furnaces.

The Pato dredge in Colombia during the months of July and August, 1914, handled 128,488 and 139,547 cu. yd respectively at a cost per cubic yard of material of 10.25 and 11.52 cents.

The most important points to be considered in the choice of tube-mill pebbles are cost, toughness, hardness, density, size and shape. Since practically all material used for the purpose consists of quartz or some form of silica, which has a specific gravity of 2.6 to 2.8, density is not often considered, except when iron balls are used, the greater weight of which constitutes the chief advantage. Hardness and toughness are important for the material ground should wear faster than the grinding substance. As to shape, the greatest grinding efficiency is secured when the pebbles are as nearly spherical as possible. Those who consider the work of a tube mill largely one of surface attrition hold that small pebbles do more grinding than large ones because they have relatively more surface. The chemical composition is not usually important; a little additional siliceous matter in the pulp rarely does harm. When iron is used the addition of fine particles of this material may have a serious effect upon subsequent operations.

The highly refractory quality of magnesite and its ability to form a hard vitreous body when combined with magnesium chloride has led to its adoption for a large variety of purposes. The largest consumption is in the manufacture of magnesite firebrick, crucibles, and refractory lining for steel furnaces. It is also used in a mixture with sand, talc and other substances in the manufacture of flooring, tileing and other artificial building material, also in the manufacture of insulating covering for steam pipes and boilers.

In order to get the maximum efficiency out of a stamp battery the stamps should fall accuartely upon the dies well under the cam-shaft. Many millmen make the mistake of using dies with small bases which must be kept in place by means of pieces of iron inserted betwen them. This is bad practice for if one piece of iron works loose the whole row of dies is thrown out of place with consequent reduction of crushing surface and efficiency.

The effect of graphite, which is often present in slaty ores, in cyanidation is still a matter of dispute, some metallusgists being convinced that it does precipitate gold, while others say it does not and that whatever precipitation occurs is due to gases occluded in the graphite.

Cripple Creek, Colo. with its rebellious telluride ores has seen many experiments in metallurgy, among them many secret and patent processes which came to a timely end. The metallurgy has now settled down to a standard practice which gives excellent results:—crushing in cyanide, removing rebellious tellurides by concentration, leaching or washing the sands, treating the slimes by air agitation with the addition of bromocyanide or other oxidizers, precipitation on zinc, either dust or shavings, and selling the concentrates to the smelters.

The quantity of pebbles used in a tube mill per ton of ore depends mainly on the hardness of the ore, the coarseness of the feed and the fineness of the discharge. In one mill which crushed quarter-inch material the consumption of pebbles per ton of ore crushed varied from 4.82 lb. to 8.73 lb. the product being 80 per cent minus 200 mesh.

Since the begininning of the use of the tube mill for fine grinding the Danish pebble has been the chief grinding medium. Its advantages are that it is hard, tough and nearly spherical. The cost of production is the cost of gathering, sorting and shipment. Unfortunately the cost of shipment to distant mining camps is heavy. The true Danish pebble is remarkably homogeneous and free from all planes of cleavage and weakness. On being fractured, the faces are sharp and irregular, and vary in color from a brownish black to a jet black. Occasionally the faces show irregular patches of foster material lighter in color. The pebbles are divided into eight sizes varying from one to 7 in. in diameter. These are sorted into different grades, varying from the "special spherical" to the culls. Millmen, as a rule, pay less attention to the shape or grade than the cement manufacturers.

The French pebble is used as a substitute for the Danish article in tube milling. On the outside it looks like the Danish and is also free from fracture planes. On fracture its color is light brown to gray in contrast to the dark brown to jet black of the Danish pebble. The French pebble is only slightly cheaper and wears faster, probably because it is softer than its Danish rival.

The development of mechanically rabbled roasting furnaces has advanced more in Europe than elsewhere, for the reason that more complex ores are treated and furnaces capable of producing sulphur dioxide from complicated blende ores and at the same time leaving the blende comparatively free from sulphur requires a calciner of great efficiency.

Counter current decantation is now in use in a number of plants without the addititon of a filter, and in many others the filter is preceded by decantation in some form or other. In silver cyaniding its use is limited by the difficulty of removing the last traces of cyanide without introducing too much water into the circulating system. The final discharge from the last thickener often contains as low as 30 per cent moisture.

A cyanide plant in Canada which uses zinc-dust precipitation has adopted a new and simple plan for collecting its precipitates. A long slender bag of light cotton material is enclosed in a slightly smaller one of heavy duck. A series of such bags are fastened to small pipe nipples on the discharge line from the precipitating pump. The inner bag does the filtering and is burned with the precipitate; the outer bag resists the pressure and is used again until worn out.

Operators of Oliver filters suggest a number of necessary conditions lack of attention to which may give rise to unsatisfactory results in the use of drum filters. The pulp should have a density of at least 1.45 and preferably higher. Vacuum should be maintened at no less than 25 in. and there should be ample agitation in the filter tank. The wash water should be applied as an atomized spray and all jets should be avoided. With the use of atomized spray the filter must be protected from the wind, or large areas of surface may escape the wash entirely.

New Publications.

Materials of Machines, by Albert W. Smith. Second Edition, Rewritten. 12mo. 215 pages, 36 figures. Publishers, John Wiley & Sons, New York. Price $1.25.

Structural Steel Drafting and Elemenary Design, by Chas. D. Conklin. 4to. 161 pages, containing many detail drawings. Publishers, John Wiley & Sons, New York. Price $2.50.

Oedema and Nephrites, by Martin H. Fisher. Second and enlarged edition. 6x9, 705 pages, 160 figures. John Wiley & Sons, New York, publishers. Price $5.00.

Descriptive Geometry for Students in Engineering Science and Architecture, by Henry F. Armstrong. 8vo., 131 pages, 114 figures. Publishers. John Wiley & Sons, New York. Price $2.00.

Handbook of Mining Details. Compiled from the Engineering & Mining Journal by the Editorial Staff. McGraw-Hill Book Co., New York. 425 pages ilustrated. Price $4.00.

Geologic Processes and Geographic Products in Arid Regions. Syllabus of a cource of lectures at the New Mexico State School of Mines by Chas. Keyes, Socorro, New Mexico. 15 pages.

Annual Report of the Secretary of Commerce of the United States for the year ending June 30, 1914, and conditions up to October 13, 1914. 210 pages, illustrated. Washington, D. C.

California Journal of Technology. Owing to the business depression the Associated Technical Students of the University of California have decided to suspend the publication of this journal.

Electric Furnace in Metallurgical Work, by Dorsey A. Lyon, Robert M. Keeney and Joseph F. Cullen. Bulletin 77, 216 pages, illustrated. U. S. Bureau of Mines, Washington, D. C.

Biennial Report of the State Inspector of Mines of Nevada for the year ended November 30, 1914, with a summary review of the report of 1913. Carson City Nevada.

Annual Report of the Director of the U. S. Mint for the fiscal year ended June 30, 1914. Also a report on the production of precious metals in the calendar year 1913. 281 pages, illustrated, Washington, D. C.

Heaton's Annual, 1915. Commercial Handbook of Canada and boards of trade register. Edited by Ernest Heaton, J. B. Robinson and W. J. Dobson. Published by Heaton's Agency, 32 Church St., Toronto, Canada. 514 pages. Price $1.12.

Canadian Mining Manual. Edited by Reginald E. Hore of the Canadian Mining Journal. Published by the Mines Publishing Co., Toronto, Canada. 273 pages. Price $2.00.

Universal Safety Standards, by Carl M. Hansen. Universal Safety Standards Publishing Co., New York. 312 pages. Price $3.00.

Proceedings of the Lake Superior Mining Institute, 19th annual meeting at Marquette range, Michigan, Aug. 31 and Sept. 1-3, 1914. Vol. XIX, 323 pages maps, illustrations. Ishpeming, Mich. Free.

Production of Coal and Coke in Canada in 1913. Compiled by John McLeish. Department of Mines, Ottawa, Canada 40 pages. Free.

University of California publications, Berkeley, 1914:

A Proboscidean Tooth from the Truckee Beds of Western Nevada. By John P. Buwalda. P. 4. Illustrated.

New Molluscan Species from the Martinez Eocene of Southern California. By Roy E. Dickerson. P. 6. Illustrated.

The Occurrence of Tertiary Mammalian Remains in Northeastern Nevada. By John C. Merriam. P. 7. Illustrated.

The Martinez Eocene and Associated Formations at Rock Creek on the Western Border of the Mohave Desert Area. By Roy E. Dickerson. P. 10. Illustrated.

Notes on the Copper Ores at Ely, Nevada By Alfred R. Whitman. P. 10 Illustrated.

The Martinez and Tejon Eocene and Associated Formations of the Santa Ana Mountains (California). By Roy E. Dickerson. P. 18. Two plates and map.

U. S. Geological Survey papers, Washington, D. C., 1914:

The Elliston Phosphate Field, Montana. By R. W. Stone and C. A. Bonine. Bulletin 580-N. P. 11. Map.

The Rutile Deposits of the Eastern United States. By Thomas L. Watson. Bulletin 580-O. P. 28. Illustrated.

The Montana Group of Northwestern Montana. By Eugene Stebinger. Professional Paper 90-G. P. 8. Illustrated.

The Moorcroft Oil Field, and the Big Muddy Dome, Wyoming. Papers by V. H. Barnett. Bulletin 581-C. P. 35 Maps.

A Reconnaissance in the Canyon Range, West-Central Utah. By G. F. Loughlin. Professional Paper 90-F. P. 10. Illustrated.

Profile Surveys in Snake River Basin, Idaho. Prepared under the direction of R. B. Marshall, chief geographer. P. 12. 37 maps.

The Rochester Mining District, Nevada. By Frank C. Schrader. Bulletin 580-M. P. 58. Map. Illustrated.

Contributions to Economic Geology, 1912. Short papers and preliminary reports. Part. II.—Mineral Fuels. Marius R. Campbell geologist in charge. Bulletin 541. P. 532. Maps. charts, index. Twenty geologists contributed to this bulletin.

Results of Spirit Leveling in Hawaii, 1910 to 1913, Inclusive. R. B. Marshall, chief geographer. Work done in cooperation with the territory of Hawaii, Marston Cambell, superintendent of public works. Bulletin 561. P. Illustrated.

Mineral Products of the United States. Review of conditions and output in 1912 and 1913. By Edward W. Parker. Also a summary of mineral production in 1913, compiled by W. T. Thorn. Advance chapter from Mineral Resources of the United States, 1913. P. 169, and one chart.

The Glacier National Park. A popular guide to its geology and scenery. By Marius R. Campbell. Bulletin 600. P. 54. Ill., map. This beautiful park is in the Rocky Mountains in Teton and Flathead counties, Montana, just south of the Canadian line.

The United Sstates Geological Survey has issued a new bulletin on tungsten, and its use as an alloy of high-speed steel—that is, steel used in making tools in metal-turning lathes running at high speed—to which it imparts the property of holding temper at higher temperature than carbon steels will. The now well-known ductile tungsten is used for incandescent lamps, which are fast displacing carbon lamps. Recently greatly improved lamps, in which the wire is wound in helices and in which the globes are filled with nitrogen, have produced a close approach to white light. These lamps are furnished in candle powers up to 2,000. Ductile tungsten is practically insoluble in all the common acids; its melting-point is higher than that of any other metal, its tensile strength exceeds that of iron and nickle, it is paramagnetic, it can be drawn to smaller sizes than any other metal (0.0002 inch in diameter), and its specific gravity is 70 per cent higher than that of lead.

A large colored wall map, showing the petroleum resources and the natural gas deposits of the United States and also the thousands of miles of trunk oil pipelines, has just been printed by the U. S. Geological Survey. The map shows the areas underlain by known oil pools and known gas pools, as well as general localities which are productive in either oil or gas, and also areas where there are noteworthy occurrences of either oil or gas but where there is no present production. The map is 49 by 776 in., printed on the scale of 40 miles to 1 inch, in 5 colors. It is printed in two sheets and is sold, unmounted, by the Geological Survey, Washington, D. C., at $1 per copy. This map not only shows graphically the oilfields and pipe-lines, but is an excellent general map of the United States.

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PERSONALS.

J. M. Platt is at Zacualpam, Mexico.

W. H. Yandle has returned to Mexico City from the central part of the republic.

Chas. A. Van Law, manager of the Real del Monte company, expects to leave for the States.

A. H. Hahn is in Pachuca.

Bruno Newman has returned to Aguscalientes.

E. A. Baylis, formerly of Madera, Chih., is in El Paso, Tex.

W. D. Pearce has returned to Chihuahua where he expects to start operations on several mining properties.

Kirby Thomas has been making investigations on some manganese properties in Virginia and the South.

N. C. Sheridan has resigned the superintendency the Interstate-Callahan mine at Sunset, Idaho, and left for Mexico.

E. A. Wayne has resigned as general manager of the Ernestine Mining company's properties at Mogollon, N. M. and gone to El Paso, Texas, to become actively interested in mining properties in Mexico.

M. K. Rodgers, well known in Mexico through his connection with mines at Guanajuato, is now one of the directors of the Granby Consolidated Mining & Smelting Co.

It is announced in the Mining Press that arrangements have been completed whereby T. A. Rickard, editor of The Mining Magazine will return to San Francisco, as editor of the Press, and H. Foster Bain will go to London as editor of the Mining Magazine.

H. W. Fowler is in Mexico City from Zcualpam.

Fred McCoy has returned to El Oro from a trip to El Paso, Texas.

Vicente Gorsave, jr. has changed from Mulage, Baja California, to Hermosillo, Son.

Chas. Rettich, formerly at Aguascalientes, is now at 1515 Monterrey St., San Antonio, Texas.

John Porter, recently of Zacatecas, is now in Mexico City.

John Pattinson, manager of the Bote mine at Zacatecas, is in London. Jas. Caldwell is in charge of the property during the absence of Mr. Pattinson.

C. A. Filteau, who has spent the last two years in Japan and Korea in the interests of American capitalists, has been appointed general manager of the Inca Mining & Development Co., Prov. of Carayaba, Dpto. de Puno, Perú, and has left for his new post.

A. S. Gangloff is manager of the Penn-Sonora Mining company's Durazno mine southwest of Nogales, Sonora.

Ed Bohlinger is located at Patagonia, Ariz.

R. Stevenson and Jack King are operating a property in the Hermosillo district of Sonora.

Arthur W. Burgren is at 539 Holbrook Bldg., San Francisco, Calif.

F. J. Nagel has returned to Mexico and is connected with the Cia. de Minerales y Metales at Monterrey, N. L.

Ben T. Wells, formerly at La Dura, Son. is manager of the Minas Alotepeque, Conception, Depto. Chiquimula, Guatemala.

Frank Hazelwood, formerly of Pachuca, is at the Elephant Butte Dam in New Mexico.

J. L. Woodul, formerly of El Oro, is in Bluefields, Nicaragua.

M. E. McDonald is in New York.

Gualterio C. Palmer is in Mexico City.

E. H. Leslie, of the Mining Press, is in New York.

Dr. Kuno Haeberlein was in Pittsburg at the dedication of the American Zinc & Chemical company's new $2,000,000 plant.

John Ryan is manager of the El Rayo company at Santa Barbara, Chih,

George Kingdon is general superintendent of the Cananea Consolidated Copper Co., at Cananea, Son.

Fred Carruthers is superintendent of the U. S. Graphite company's mines in Sonora.

Harold Whealton is operating the El Plomo mine in the Altar district of Sonora.

Frank H. Sistermans is in Nicaragua investigating mining properties.

Hubert Merryweather, formerly with the Juragua Iron Mines Co., of Cuba, is general manager of the Bethlehem-Chile Iron Mines Co., near Coquimbo, Chile.

Paul W. Meyers has left for Colombia to take a position with the Colombia Exploration Syndicate of Philadelphia.

D. P. Gillis, Frank Jenkin and Glen Anderson, of El Oro, were Mexico City visitors last month.

Dr. Norton succeeds Dr. H. J. Geitz as physician at the Esperanza company, El Oro, Dr. Geitz going to Pachuca with the Real del Monte company.

Fred F. Meloche is at Nelson, B. C. He will leave soon to take charge of a mining property in Alaska.

END OF THE TRAIL.

Tom Graham, well known throughout Mexico as a newspaperman and miner, died of Bright's disease at the American Hospital, Mexico City, April 11. He was buried in the British cementery, Mexico City.

H. E. O'Driscoll died in Denver, Colo., Dec. 30 from the result of wounds received at Durango, Mexico, in an encounter with bandits. He had been engaged for a number of years as mining engineer in Mexico and the Southwest.

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In multiple hearth roasting furnaces it has been found that the arch of an intermediate hearth should have a rise of not less than ½ in. to the foot in order to render it safe against collapse.

Most European multiple-hearth roasting furnaces have a jack at the bottom of the rabble shaft, so the rabbles may be raised or lowered as the furnace changes in temperature.

Between the placer mining property which can be successfully worked with pick and shovel and that which can be worked by dredging there is an enormous amount of ground which carries a good gold content. The material is too low-grade for working by the usual mining and milling processes and no water is available for dredging.

A recent comparison of the cost of a round steel ore bin built on a concrete foundation of ¼ in. steel at 3.75 cents per pound with that of a wooden bin of the same capacity and of the ordinary type shows to the advantage of the steel bin. The cost per ton capacity of the steel bin was $5.50 and that of the wooden bin, $7.94.

In spite of the apparently well-founded view that the average ore from a breaker can be crushed more economically with rolls, provided that they are properly handled, builders of new cyanide plants seem content to rely largely on the gravity stamp. It is true that rolls have been adopted in some instances, as have also Chilean mills and ball-mills, but by far the majority seem to persist in the idea that stamps are an essential feature in milling gold and silver ores. Screens with large openings are being used, three-mesh being fairly common in the mills of the United States during the past year.

Late conclusions in regard to tube-milling is that power consumption is independent of the feed, while, up to a certain point, ultimate efficiency is proportional to the feed.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1813	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59.207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58.175	28.038	27.825	26.704
June	61.290	58.990	58.471	28.215	27.199	26.948
July	60.654	58.721	54.678	27.919	27.074	25.219
August	81.606	59.293	54.344	28.375	27.335	25.979
September	63.078	60.640	53.290	29.088	27.986	24.260
October	63.471	60.793	50.654	29.299	28.083	23.199
November	62.792	58.995	49.082	29.012	27.263	22.703
December	63.365	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14.672	61.603	14.871	.....	87.140	66.274
July	14.190	13.223	14.563	.....	64.166	64.955
August	15.400	.....	15.904	.....	69.200	53.227
September	16.328	.....	16.799	.....	73.125	.....
October	16.337	.....	16.913	.....	73.383	.....
November	15.182	11.739	16.022	.....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1913	1914	1913	1914
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.655
March	46.832	38.038	213.615	173.819
April	49.115	36.154	224.159	163 863
May	49.038	33.360	224.143	150 702
June	44.820	30 577	207.208	138.321
July	40.260	31.707	183.511	142.517
August	41.582	...	188.731	... .
September	42.410	32.675	193.074	.....
October	40.462	30.284	184.837	.....
November	39.810	33.304	180.869	139.391
December	37.635	.....	171.786	.....
Av. year	44.252	....	206.279	... .

New York in cents per pound; London in pound sterling per long ton.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.850	15.977	18.651
Apri	4.381	3.810	4.242	3.683	17.597	18.225
May	4.342	3 900	4.226	3.863	18.923	18.503
June	4.325	3.800	4.190	3.810	20.226	19.411
July	4.353	3.891	4.223	3.738	20.038	19.051
August	4.624	3.875	4.550	3.715	20.406	
September	4.698	3 828	4.579	3.658	20.648	
October	4.402	3.528	4.253	3.384	20.302	
November	4.293	3.683	4.146	3.585	19.334	18.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	6.931	5.262	6.854	5.112	26.114	21.583
February	6.239	5.377	6.089	5.227	25.338	21.413
March	6.078	5.220	5.926	5.100	24.605	21.460
April	5.641	5.113	5.491	4.963	27.313	21.569
May	5.406	5.074	5.256	4.924	24.583	21.393
June	5.124	5.000	4.974	4.850	22.143	21.345
July	5.278	4.920	5.128	4.770	20.592	21.568
August	5.658	5.568	5.508	5.418	20.706	
September	5.694	5.380	5.444	4.230	21.148	
October	5.340	4.909	5.188	4.750	20.614	
November	5.229	5.112	5.083	4.962	20.581	25.016
December	5.156		.004		21.214	
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

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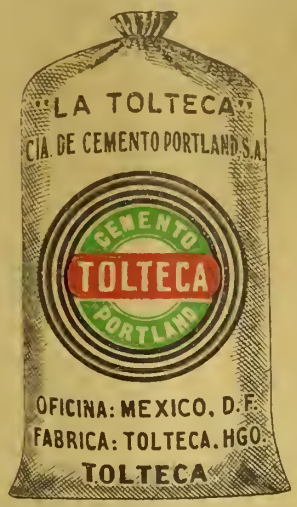

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MEXICO, D. F.

TRADE NOTES

Lunkenheimer Co., Cincinnati, Ohio. A recent catalogue describes the "Ferrenewo" valves manufactured by the company.

The Lagonda Manufacturing Co., Springfield, Ohio, has just issued a new bulletin Lagonda Boiler Tube Cleaners. Copies may be had on request.

De Laval Steam Turbine Co., Trenton, N. J. has issued the most complete publication devoted solely to centrifugal pumps. It has 298 pages and over 300 illustrations.

Western Electrical Co., St. Louis, Mo., has issued its "Electrical Supply Year Book", comprising 1216 pages.

Goodyear Tire & Rubber Co., Akron, Ohio, has issued catalogues as follows: Mechanical Rubber Goods; Flat Conveyor Belts: Mine Equipment; Balata Belting and Kantkink Flexible Metallic Hose.

Connersville Blower Co., Connersville, Ind. Catalogue No. 16 treats of the Connersville Cycloidal Pumps manufactured by the company.

The Merrill Metallurgical Co., of San Francisco, Calif., has recently secured a large contract for Merrill Automatic Sluicing Slime Filters for the Aurora Consolidated Mines Co., of Aurora, Nevada. The equipment will include three 124 frame 3'×4' × 2½" filters of the most improved design and will have a minimum capacity of 500 tons of slime per day.

The Pelton Water Wheel Co. in its new publications, Bulletin 8 entitled "The Pelton System of Power," gives a great deal of information on hydraulics and hydraulic power that has never before been published. It deserves a place on the shelves of every engineering or industrial library. Besides giving illustrated descriptions of the various types of motors and the manner of installation and the uses to which they can be put, the booklet contains formulas and calculations showing methods for determining horse power, efficiency, speed, pressures, etc., as well as tables and data required for estimates. The future of Mexico lies in the development of hydraulic power. Bulletin 8 will be sent upon request to either the San Francisco or New York office of the company.

Chalmers & Williams are distributing new pamphlets devoted to the new quick discharge for tube mills, the Symons disc crushers, the "Nissen stamps," and tube mill grinding in general. Catalogue P describes the patented discharge for tube mill heads with adjustable lifters, besides giving important data for calculating the capacity and regulating the size of product. Section Q. R, on the Symons crusher, goes into the new principles involved in this machine which crushes between two manganese steel discs revolving in the same direction at the same speed but at a slight angle to one another.

A statement made in a publication issued by the Denver Quartz Mill & Crusher Co. has recently attracted a great deal of attention. It is that the No. 3 eight-foot Denver quartz mill has a capacity of 100 tons per 24 hours and consumes only 17 horse power. That is more than 5 tons per horse power. Unfortunately the character of material or the fineness of feed and discharge are not given. But it is a record nevertheless. These mills grind by means of immense steel rolls having a convex tread and running around a circular groove track. The material automatically falls into the groove under the crushing rolls. This company also makes a steel jaw crusher.

The Mesta Machine Co., Pittsburgh, Pa. in Bulletins O and I presents descriptions and illustrations of rope drives and gas engines manufactured by this company. The publication contains much information on this and kindred subjects. The gas engines of this company are built for all classes of service and for all fuels.

S. Flory Manufacturing Co., Bangor, Pa., is distributing an attractive bulletin describing and illustrating the hoists, derricks and cable ways employed in the construction of the Kensico dam. This equipment included two 12-ton cable ways, two tower moving hoists, nineteen 17 h. p. two-speed hoists operating travelling derricks on the dam and at the quarries.

Percy Pitman, 25 Victoria St., Westminster S. W. London, is issuing a publication describing fluid pressure governors for controlling the speed of water wheels, Pelton wheels, etc. This firm also manufactures Pelton wheels for a variety of purposes.

The McCord Manufacturing Co., Detroit, Mich., is distributing its catalogue No. 12, describing force-feed lubricators for steam and gas engines, compressors, Diesel engines and other heavy duty bearings. Construction and operation of the appliance is fully illustrated and explained.

The Holt Manufacturing Co., Stockton, Cal. in Bulletin T. E. 61 gives the advantages of the caterpillar tractor engine for all classes of heavy hauling. The tractor built by this company hauls wagon trains on all sorts of road and should be useful to many mining companies in Mexico when business is resumed and operations may be hampered by the scarcity of draft animals.

The Denver Engineering Works Co., Denver Colo., in Bulletin 1065 describes its smaller hoists which are especially adapted for use in stopes and winzes. They can be mounted on mine flat cars and thus made to serve as portable hoists.

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Director de esta Sección:
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El Mexican Mining Journal cuenta con un competente personal dedicado exclusivamente á contestar todas las preguntas ó consultas que se le hagan sobre cualquier asunto relacionado con la Minería; ya sea respecto á maquinaria, á implementos mineros, ó tratados sobre la materia ó á sus ciencias auxiliares, y en general, sobre cualquier punto ó duda que tengan nuestros lectores: pues nuestro único propósito es ayudarlos en todo lo que nos sea posible, siendo nuestro mayor placero contestar á todas las preguntas ó consejos que se nos hagan. Este servicicio es absolutamente gratuito para nuestros abonados, quienes podrán hacer uso de él cuantas veces lo soliciten.

Igualmente penemos á la disposición de nuestros lectores las columnas de The Mexican Mining Journal para que puedan tratar en ellas todo aquel asunto que sea de interés general, siempre que no esté en pugne con la índole de nuestra publicación.

Todo aviso de suspensión deberá dirigirse precisamente á la Oficina de la Ciudad de México.

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Una Nueva Sección.

Dada la gran importancia que día a día adquieren los negocios petrolíferos en México, hemos decidido desde el próximo número, publicar una Sección en The Mexican Mining Journal que contendrá valiosísimos datos y noticias referentes a tan rica industria.

El hecho de estar nuestro Journal publicándose sin interrupción desde hace muchos años nos ha facilitado la oportunidad de poder conocer extensamente los negocios mineros de México, así como también la de adquirir valiosas relaciones entre los interesados en esta clase de negocios tanto del país como fuera de él, cuyas circunstancias hacen que se nos facilite, más que a ninguno otro, el poder publicar con oportunidad datos que serán de indiscutible utilidad para todos.

The Mexican Mining Journal será actualmente en México el único periódico en inglés que se dedique a dar a conocer tanto en la República como fuera de ella los sorprendentes adelantos que en este país ha alcanzado la industria petrolera.

Al mismo tiempo publicaremos los procedimientos más modernos en práctica en el extranjero, así como todo lo que en nuestra opinión pudiere favorecer al desarrollo de esta importante fuente de riqueza.

Ponemos desde ahora a la disposición de nuestros lectores la nueva Sección que vamos a inaugurar de igual manera que nuestro Journal para que en él puedan publicar sus trabajos, los cuales tendrán favorable acogida siempre que sean de interés general.

Recursos Mineros de la Provincia de Ambo, Perú, S. A.

De conformidad con la ley de 21 de octubre del año de 1912, que creó esta nueva provincia, sus linderos, aún no muy definidos, son: por el norte con las quebraduras de Ñausa y de Conchamarca o Sancarragra, por el Sur con los ríos Chacachincha y Salcachupán, por el Este con la cordillera oriental, que separa la cuenca del Huallaga de la del Pozuzo, y por el Oste los actuales linderos de Cayna y Huacar con la provincia del Dos de Mayo.

La superficie de esta nueva provincia se puede calcular en cuatro mil kilómetros cuadrados, y sus habitantes en veinte y cuatro mil, o sea seis habitantes por kilómetro cuadrado.

Partiendo del lindero Sur de la provincia, o sea de Salcachupán, existen sobre el río Huallaga varios puentes de palos, poco resistentes y de precaria duración, entre ellos merecen ser considerados los siguientes: el de San Rafael que sirve para los pueblos de Chacos y de Matihuaca, el de Huaylla que une al camino principal el caserío del mismo nombre y el de Tomayquichua por la misma razón. En el mismo Ambo y sobre el Huallaga existe un puente de cal y piedra muy sólido y resistente, que da paso a los habitantes de la orilla derecha del citado río, y pone a la vez en comunicación Ambo con Tomayquichua.

Partiendo del lindero Suroeste o sea del río Chacachincha, se encuentran sobre el río Huertas tres puentes de cal y piedra, que ubican en los sitios siguientes: el 1º en Huertas, que sirve para los pueblos situados al Oeste del río: Cayna, Parcoy, Masquin, Coquín, Colpas, Yamor, Quio, y Yapac y Lauricocha. El 2º en Huacar para la comunicación de ese pueblo con el camino que conduce a Goyllarisguisga, y el 3º en el mismo Ambo, para la comunicación de esta ciudad con Huánuco. Un sín número de puentecitos unen los distintos pueblos entre sí y que, después de la época de lluvias, tienen que ser construidos nuevamente.

Un camino casi carretero de ciento cinco kilómetros de largo, une la ciudad del Cerro de Pasco, capital del departamento de Junín, con Huánuco capital del departamento de su nombre. Este camino atraviesa de Sur a Norte el territorio de la provincia de que me ocupo en una extensión de 48 kilómetros, desde el Molino, lindero Sur y hasta la quebrada de Ñausa, lindero Nortet recorriendo siempre la orilla izquierda del río Huallaga.

Otro camino importante es el que conduce a Yanahuaca y a Goyllarisguisga, siguiendo desde Ambo la orilla derecha del río Huertas. Esta ruta al partir de Ambo y hasta Viroy, trece kilómetros, se presenta casi carretera, de este último punto y hasta Huarmihuanusga es accidentado con muchas subidas y bajadas, y en sitios es peligrosa y estrecha. En Huarmihuanusga se bifurca el camino, uno para Goyllarisguisga y otro para Yanahuanca, siguiendo el primero por las alturas Antapirca y quebrada de Tusi, el segundo las orillas del río de Huertas.

En este segundo camino y en el sitio llamado Huspachaca se construyó el año pasado un puente de fierro sobre el Huertas, evitándose con esa obra la antigua ruta de Tangos, larga y accidentada y con grandes subidas y bajadas; hoy, la comunicación entre esta provincia y los pueblos de la quebrada de Chaupihuaranga, resultaría relativamente corta y fácil.

Un camino secundario, de quince kilómetros de largo, une Ambo a Tomayquichua primero y a Conchamarca después, siguiendo siempre la orilla derecha del Huallaga.

A más de los citados, existen los caminos secundarios que van de pueblo a pueblo, muy accidentados y con gradientes muy fuertes, intransitables en las épocas de lluvias y cuya manutención y conservación corre a cargo de dichos pueblos. La resistencia de esos poblanos es cosa que asombra, no se fatigan subiendo de la quebrada a las alturas por horas y horas; y constantemente se ve que llegan primero que los jinetes en buena acémila, habiendo salido juntos. Ellos no siguen la ruta trazada, que siempre es la de un zig-zag, van acortando subiendo o bajando verticalmente, de manera que para ellos no interesa el camino, y si lo conservan, es para trasportar en bestias los productos de sus sembradíos.

Por la superficie montañosa de esta provincia, el sistema orográfico presenta dificultades mil para ser bien estudiado; los contrafuertes de la cordillera de los Andes al Oste, la cordillera oriental o de Huachón al Este y los cerros de Vinchos, Quircán y Mosca al centro, forman una infinidad de avallamientos casi siempre angostos y llenos de precipicios donde ubican la mayor parte de los pueblos de esta provincia, y adonde se efectúan las siembras de papas y cereales. La cordillera de los Andes, gradualmen-

te descendiendo, forma la quebrada de Huertas, los puntos culminantes en la provincia son: los cerros de Rondoní, que dividen los ríos de Colpa y de Cayna y se elevan a más de 4,500 metros de altura; los de Santa Bárbara, que forman el lindero de la provincia de Huánuco y de altura igual a los anteriores y finalmente los de Auquincoto, que forman a la vez la quebrada de Ñausa.

La cordillera oriental, tiene su origen en el nudo de Huachón de la provincia de Pasco, corre casi de Sur a Norte, divide la cuenca del río Huallaga de la del Pozuzo, y se eleva a más de 5,000 metros el nevado de Saxahuanca, conservando en su formación una altura no inferior de los 4,000 metros en toda su extensión. La cadena de cerros del centro, está formada por el desprendimiento del nudo de Vinchos, avanza hacia el Norte, paralelamente a los dos sistemas citados, divide el río Huallaga del de Huertas y conculye en la confluencia misma de estos dos ríos. La altura de esta cadena secundaria es de 4,000 metros, el punto culminante es el de Pachupupum de más de 4,500 metros, y sobre cuya falda ubica el pueblo de Chauchac.

Partiendo del pueblo de Chacos al Sureste, las faldas de los cerros que se desprenden de la orilla oriental, y hasta el extremo Norte de la provincia, está formados casi todos de arenisca metamórfica a base de ondecita, cuarcita y de esquistos micaceos. En la parte más elevada, se encuentran pequeñas vetas de plomo argentífero y de chalcopirita, que no sería práctico explotarlas; en cambio en el fundo Alcas de propiedad de los señores Santiago F. Anselmi y Emilio Scheuerman, existe una poderosa veta de chalcopirita, cuyos minerales ensayan de 8 a 15 por ciento de cobre y de 10 a 60 onzas de plata por tonelada métrica. La distancia y la falta de faciles caminos así como la del combustible, son la causa de que no se pueda explotar con resultados positivos esa valiosa zona, amparada por los citados propietarios, a pesar de ser constantemente visitada por ingenieros nacionales y extranjeros.

Cerca de Ambo y a la orilla del Huallaga existen los lavaderos, que fueron amparados hace tres años por los señores Seckels, Cútolo, Harris, Mc Cune y otros. Parece que el río Huallaga en su secular y gradual descenso, haya dejado a un nivel más alto los actuales terrenos, que en algunos puntos se elevan a más de 40 metros sobre e lactual cauce del río citado. El promedio de las muestras sacadas dió un resultado de cuarenta centavos a cuatro soles de oro por tonelada, mientras que algunas de esas muestras dieron resultados fabulosos. Se ignora la causa del abandono de esos lavaderos, después de ingentes gastos, unos aseguran que es por el fracaso del ferrocarril al Ucayali, y otros porque el oro contenido no se halla al estado libre, resultando por consiguiente costosa la explotación.

En el lugar llamado Malpaso, comprensión del pueblo de Mosca y en el mismo lindero, existe el mineral conocido con el mismo nombre de Malpaso, en el que se explotan hoy en abundancia minerales de cobre, chalcopirita, que ensayan de 10 a 18 por ciento de cobre, con pequeña ley de plata. Las vetas corren de Este a Oeste, y la potencia de ellas es variable, penetrando la oxidación más allá de la profundidad alcanzada actualmente. Los minerales que se explotan de esta región, se benefician en el horno instalado en Vinchos, 14 kilómetros distante, a donde se transportan a lomo de llamas y a razón de seis a siete soles por tonelada métrica. En la actualidad, con muy pocos operarios, se explotan tan sólo de diez a quince toneladas diarias, pudiendo esta explotación elevarse al doble y más aún, aumentando el número de operarios, e instalando maquinarias para bombear las aguas, perforar y extraer dichos minerales. El antigua minero y vecino del Cerro de Pasco, don Alejandro Nation, propietarios de la mitad de las minas de Malpaso, construyó en el sitio llamado Yanacocha un horno de manga, para beneficiar en él los minerales aludidos.

De Malpaso, avanzando hacia el Norte, se encuentran cerca del pueblo de Chauchac muchas vetas de chalcopirita, explotadas en años anteriores por una sociedad ambina, y después abandonados por la falta de fáciles vías de comunicación.

Partiendo del riachuelo "Chacachincha," se encuentran en los cerros de Rondoni muchas vetas de chalcopirita y de plomo argentífero, de potencia variable. En esta importante región el señor Franck Klepetko tomó posesión de 95 pertenencias mineras con once amparos; y el señor Manuel Mújica Carassa de dos pertenencias. Los cerros de Santa Bárbara, de formación igual a los anteriores, presentan varios filones de plomo argentífero en la parte más elevada, y estrados de chalcopirita también en la parte media y baja, pero de menor importancia de las de Rondoni. A espaldas de los cerros de Rondoni y de Santa Bábara, y en el lindero mismo de esta provincia con la de Huánuco, existe el importante mineral de Huaraucaca (Chaulán); para mejor describir esa zona, hago míos los estudios consignados en el folletín número 9 y en el tomo primero de "La minería en el Perú" respectivamente. La roca predominante en los cerros de Huaraucaca y Tullucarpa es la caliza, que se presenta en gruesos estrados plegados en dirección N. S. y que forman un anticlinal en el primer cerro, por cuyo eje aparece un dique de pórfido. A pocos kilómetros de distancia se encuentra la extensa formación de esquistos arcillosos y micaceos, subyacentes a la caliza, así como masas de diorita que afloran por diferentes partes, como en la quebrada de Quio. Los filones auríferos atraviesan la caliza con dirección N. S. y con inclinación al Oeste, pero más fuerte que la que tienen los estrados. Entre los varios filones conocidos y explotados antiguamente, se distinguen los dos cuyos afloramientos aparecen en la falda oriental del cerro, distantes doce metros entre sí.

El relleno de esos filones está constituido principalmente por minerales rojos provenientes de la oxidación de los sulfuros (pirita, marcasita, y pintas de chalcopirita y panabás), que con la ganga de cuarzo y calcita constituyeron el relleno primitivo. La zona de oxidación penetra hasta la mayor profundidad hasta hoy conocida.

La potencia es variable, por corresponder a una fractura con resbalamiento. Hay a la vista una zona de seis metros de ancho, en la que se encuentran muchas labores de las que se han sacado muestras de diferentes leyes, hasta de 180 gramos de oro por tonelada métrica. La ley corriente de oro es de 20 a 40 gramos, en plata de 200 a 6,000 gramos y en cobre de 6 a 30 por ciento. En las canchas hay más de seis mil toneladas de mineral con 17, 21 y 24 gramos de oro, 250 gramos de plata y 6 por ciento de cobre.

Finalmente en los cerros de Auquicco, que dividen las quebradas de Huertas y de Ñausa, se encuentran varias labores desde hace tiempo abandonadas, que por la profundidad y derrumbamiento interiores, demuestran haber sido explotadas con provecho por los antiguos.

En cuanto al carbón, este solo se encuentra en las alturas de Margos y de Chaulan de la provincia de Huánuco, y en Goyllarisguisga y Yanahuanca de la provincia de Pasco, en esta provincia solamente se encuentra andacita en abundancia, pero de mala calidad y con bastante grafite. La única vetilla de buen carbón que merece considerarse es la de Cumbe, alturas de Ñausa, sin duda con trabajos de exploración, pudiera resultar abundante, y práctico el explotarla.

A excepción del mineral de Malpaso, todas las demás zonas mencionadas, sólo se explotarán con provecho, cuando una vía fácil, rápida y económica, permita acercar Ambo a los lugares de consumo y expendio, a menos que no se instalen oficinas de beneficio en la quebrada de Huertas, la que cuenta con la facilidad de la fuerza hidráulica en toda su extensión.

Se dice que en ciertas factorías de Bélgica acaba de adoptarse un nuevo sistema por medio del cual no sólo se evita la salida del humo sino que se utiliza éste para determinados fines. El humo es impelido por medio de abanicos hacia un receptáculo poroso dentro del cual pasa una corriente continua de petróleo o de otro líquido similar. El humo es aprisionado allí y convertido en gas que se utiliza para la calefacción y para el funcionamiento de motores.

La Precipitación por Medio del Carbon Vegetal de las Soluciones de Cianuro.

La precipitación del oro y de la plata de las soluciones de cianuro por medio del carbón vegetal ha estado siendo objeto de grandes estudios de parte de los operadores que tratan de determinar cual es la causa de la precipitación. Se ha llegado a admitir que el carbón por sí sólo no es el que ocasiona la citada precipitación, y la mayoría de las autoridades en la materia atribuyen esta responsabilidad a los gases contenidos en las partes porosas del carbón vegetal. Al discutir esta fase de ese asunto el Sr. A. F. Crosse conviene en que los gases condensados en el carbón vegetal son mucho más activos que en su estado libre ordinario. También se admite que tanto el oxígeno como el monóxido de carbono han sido encontrados en el carbón vegetal y él mismo se pregunta de por qué estando juntos estos elementos no se combinan y forman bióxido de carbono.

Continuando la misma discusión el Sr. F. J. Pooler pretende que una analogía entre la acción del carbón vegetal y el grafito no puede ser de un valor corroborativo, por razón de la diferencia radical que existe entre las estructuras de los dos cuerpos. No obstante que ambos son compuestos carbonosos ellos son enteramente distintos en su estructura y desde el momento que el grafito no tiene ningún efecto en las soluciones de cianuro esta es una conclusión evidente de que el carbón inerte no es el que afecta las soluciones. El mismo señor continúa preguntando que desde el momento en que el monóxido de carbono ha pasado a una solución ordinaria conteniendo oro no precipitará éste, qué cual es la razón que existe para creer que lo hace en el carbón vegetal a menos que el carbón de por sí tenga alguna acción.

La acción catalítica del carbono no depositado en el carbón vegetal puede ser que sea la responsable de la acción. La catálisis sin embargo, no significa necesariamente que la acción se verifique con o sin la ayuda del monóxido de carbono. La prueba del carbón vegetal y de las otras formas de carbón como precipitantes del oro y de la plata de las soluciones distintas a las del cianuro podrían dar alguna luz a este asunto. Parece posible que las funciones del carbono fino se verifican tanto en el fenómeno de la absorción del gas como en la acción catalítica. El cianuro de potasio es tan variable que la estructura del carbono depositado puede tener algún efecto en la solución.

La Industria de la Cianamida de Calcio.

Las plantas fábricas de la American Cyanamid Co., en la catarata del Niágara Ontario, comenzaron sus operaciones en enero de 1910. La planta principal tuvo una producción anual de.... 12,000 toneladas, que en 1912 se aumentó aproximadamente a 30,000 toneladas anuales y los aumentos posteriores van a dar una producción de 64,000 toneladas al año.

Desde el principio de las operaciones, se vió claramente que una producción de 12,000 toneladas anuales no bastaba a las exigencias del mercado. Pero los directores de la compañía adoptaron el plan de probar primero una instalación pequeña. Pasados dos años vieron que el producto había tenido un gran éxito comercial y que se hacía necesario duplicar la planta existente para satisfacer los pedidos, los cuales crecían continuamente.

La cianamida de calcio es una substancia de color negro azulejo, inodora que contiene de 18 a 20% de amoníaco, un 12% de carbono y unas 70 libras de cal. La materia se embarca en sacos y puede almacenarse por un tiempo definido. El nitrógeno de la cianamida es rápidamente soluble. El agua fría disuelve un 96%, por cuya razón constituye un valioso alimento para las plantas. En contacto con el suelo, reacciona en el acto formando primero urea y trasformándose después en sales dobles de amonia. Cien libras de cianamida contienen más o menos 70 libras de cal, que contribuyen a hacer de ella un podoroso fertilizante.

La fabricación de la cianamida está basada en el hecho de que el carburo de calcio, calentado a alta temperatura, se combina con el nitrógeno atmosférico produciendo la cianamida. El carburo de calcio se prepara fundiendo en el horno eléctrico una mezcla de cal y coke; el carburo se coloca en seguida en hornos calentados por la electricidad hasta el blanco, donde se hace llegar el nitrógeno que se combina con el carburo formando la cianámida. Después de fría se muele, se trata con agua y se somete a un proceso mecánico final.

Antes de la instalación de la planta de cianámida en Niágara, se estudió el importante problema de determinar la clase de gas reductor que era necesario emplear para preparar el nitrógeno. Después de un trabajo cuidadoso, se resolvió instalar una fábrica de gas de alumbrado, cuya producción total de coke podía emplearse en la manufactura del carburo; además, el gas daba la mayor parte de su contenido de carbono para usarlo en los hornos de nitrógeno. Estos hornos están formados por una serie de retortas verticales calentadas por pequeños hornos separados; en estas retortas se coloca óxido de cobre y una vez que éste alcanza la temperatura conveniente, se hace pasar aire por los hornos. El oxígeno se combina con el cobre formando óxido de cobre dejando el nitrógeno en libertad; se expulsa el aire, y como el óxido ha ido poniéndose inerte y perdiendo su oxidabilidad, se hace pasar gas de alumbrado a través de las retortas, el cual obra como un agente reductor. Entonces se introduce el nitrógeno por medio de tubos en los hornos eléctricos y allí se combina con el carburo produciendo la cianámida.

La planta para la fabricación de la cal que se iba a usar fué ideada e instalada por la Improved Equipment Co. La planto original consistía de seis hornos de cal Doherty-Eddred montados según el procedimiento Eldred, modelo inducido, pero la planta actual ya se compone de doce hornos.

En la planta original y en la reforma de 1912, el nitrógeno se producía mediante el procedimiento del óxido de cobre, pero en la modificación de 1913, se preparó este gas por medio del aire líquido. Están en trabajo tres series completas de los aparatos Claude para aire líquido, construídos por L'Air Liquide de París.

Estos aparatos operan a una presión de 600 libras por pulgada cuadrada y a una temperatura de unos 300° Fahrenheit. El nitrógeno sale con una pureza de 99.9% y el oxígeno alcanza rara vez a un 0.1%. La planta de coke y gas, con una capacidad de 500,000 pies cúbicos por día, fué instalada también por la Improved Equipment Co.

Los esfuerzos de los manufactureros se dirigieron a simplificar y abaratar el procedimiento de fabricación así como a mejorar el producto como fertilizante comercial, puesto que había mercados suficientes para consumir la producción total. Sin embargo, la substancia es susceptible de otros usos. Es bien sabido que cuando se funde con carbón y un agente disgregante apropiado, se trasforma en cianuro. El producto bruto puede usarse directamente en la cianuración de minerales de oro y plata, o puede someterse a tratamientos especiales que produzcan el cianuro en una forma más pura.

En el procedimiento original de Castner para la preparación del cianuro de sodio, el gas amoníaco es absorbido por el sodio a 400° C., con formación de amida y desprendimiento de hidrógeno:

$$NH_3 + Na = N H_2 Na + H$$

Fundida con una molécula de cianuro de sodio, la amida es convertida en cianámida de sodio entre 550 y 600°:

$$NH_2 Na + Na CN = CN_2 Na_2 + H_2$$

La cianámida, mezclada con carbón y calentada de 750° a 800°, se combina con él para formar cianuro.

El uso de moléculas intermediarias de cianuro puede evitarse procediendo de una manera diferente. Se emplea un primer átomo de carbono para convertir dos moléculas de amida en cianámida de sodio, y después, a 800°, un segundo átomo de carbono para producir cianuro:

$$2\ NH_2\ Na + C = Na_2\ CN_2 + 2H_2$$

$$Na_2\ CN_2 + C = 2\ Na\ CN$$

Los métodos corrientes de manufactura del cianuro hacen uso del sodio como álcali, mientras que la cianámida comercial emplea el calcio; pero no hay razón ninguna para creer que este último es menos eficaz que el primero en operaciones metalúrgicas, con tal que exista la misma cantidad de nitrógeno.

Los polvos para el endurecimiento y cementación constituyen una segunda clase de derivados importantes del cianuro, pero todos contienen cianámida como base del nitrógeno. Los polvos para endurecer se aprovechan en forma análoga al cianuro, cuero quemado, etc. Los polvos de cementación se emplean para hacer cemento y acero en hojas. Otra clase de derivado encuentra aplicación en la fabricación de explosivos, tales como la diciandiámida, guanidina, nitroguanidina, nitrato y nitro de amonio. La urea, usada junto con la diciandiámida en la industria de los colores, puede derivarse también de la cianámida.

El dueño de una poderosa refinería en Hanau, acaba de adquirir tres interesantes pepitas de platino, o "samorodkis" como se las llama en Rusia. Son ellas tres verdaderas rarezas. Fueron halladas en las arenas del río Iss, cerca de Nishne-Tagil, en los Montes Urales. Su peso total es de 17.122 kg. o sean 550 onzas. Sus respectivos pesos individuales son, 7,782, 4,775 y 4,566 kg. Se las avalúa en $25,000. La más grande fué hallada hace 25 años y las dos restantes hace 20. Desde entonces hasta hoy no han vuelto a encontrarse pepitas de aquel mismo tamaño.

El bloque más grande de platino que hasta hoy se conozca fué descubierto, hace 100 años, en la misma región antesnombrada. Puede admirársele hoy, como la más rara de todas las curiosidades naturales de su clase, en el Museo de Demidoff existente en Petrograd. La más grande de las tres pepitas a que nos hemos referido atrás, ocupa el segundo sitio después de ésta. Contiene 86.5 por 100 de platino puro, 3 por 100 de iridio y pequeñas cantidades de otros metales. Podría pensarse que en sitios donde tan grandes bloques de platino se encuentran el hallazgo de dicho metal en pepitas de tales dimensiones es cosa frecuente. No ocurre así, sin embargo. Aun el hallazgo de bloques que pesan sólo 20 o 50 gramos es suceso muy raro.

Recursos Mineros de la Parte Occidental de la Región Norte de la Baja California.

El Mineral del Alamo.—Es el más importante del Distrito Norte de la Baja California; se encuentra a 1,135 m. sobre el nivel del mar; fué descubierto en 1901 un poco después del Mineral de la Biznaga que distará unos 4 kilómetros al N. W. del Alamo.

El mineral por el que se ha explotado es exclusivamente oro nativo. Alcanzó en la primera década de su descubrimiento una producción de regular importancia, puesto que lo manifestado a las autoridades en Ensenada suma un valor de $3,200.00, asegurándose por personas de todas clases que lo no manifestado debe ser mucho mayor de esta cantidad, dadas las condiciones especiales como se ha hecho el comercio del Distrito Norte con los Estados Unidos.

Las minas principales son: La Princesa, La Aurora y San David, y varios tiros o fundos dependientes de estas minas. La profundidad mayor de las minas alcanza 360 pies en La Princesa y San David.

Con motivo de la revolución de 1911, los trabajos en las minas se suspendieron por lo que el agua inundó las labores y cuando nuestra estancia en el lugar, en Octubre de 1911, nos fué imposible poder visitar las minas, pues sólo en el tiro de la Cruda se principiaba a reparar el camino y el motor para comenzar los trabajos.

La roca general es una diorita (?) de color obscuro, al E. muy cerca se encuentra un poderoso macizo de rocas metamórficas con una direcció ngeneарl de 56° N. W. y 69° echado al N. E. Las vetas tienen una dirección general de 70° N. W. y 80° echado al N. E., cortadas por varios diques paralelos de diabasa (?) de diferentes espesores que varían desde 70 cm. hasta 1m.50, teniendo estos diques una dirección general de 35° N. W. y 65° echado al S. W. Nos aseguraron que las vetas se terminan en una falla que corta vetas y diques con una dirección como de 45° N. W.

El espesor de las vetas varía desde varios centímetros hasta un metro con llenamientos de cuarzo ferruginoso con oro nativo; a la profundidad de 60 pies ya existe magnetita relativamente abundante y más raramente blenda y galena, aumentando la proporción de estos minerales en los niveles más profundos.

Se encuentran también serpentina y asbesto que provienen seguramente de los planos de deslizamiento de fallas posteriores a la formación de las vetas y de los diques.

En el macizo de las rocas metamórficas que distará unos 2,000 m. de las minas anteriores, existen vetas de cuarzo aurífero muy fracturadas y de tamaños reducidos de donde probablemente proviene el oro de placer que se encuentra en el Río de Oro, como se le llama por los gambusinos al arroyo del Alamo, quienes repetidas veces han volteado las arenas obteniendo muchas regulares utilidades. En este arroyo hicieron una instalación para labrar el oro por el sistema hidráulico, pero parece que no les dió resultado.

En el Alamo, como en muchas partes, dicen: que el estado raquítico de la minería es debido a las compañías y gerentes que sólo se preocupan por dar golpes financieros y no por trabajar las minas bajo un plan técnico, económico y adecuado; los mineros de buena fe y con empeño en trabajar hasta obtener éxito, parece que casi siempre son de escasos recursos; es muy probable que efectivamente esta sea una causa de que la minería no prospere en aquel lugar.

El Mineral del Real del Castill.o—El Mineral de Real del Castillo y el de Jacalitos son semejantes: los dos son minerales de oro en cuarzo que arman en micaesquistos. El primero se encuentra en la parte final del amplio Valle de San Rafael a 680 m. sobre el nivel del mar; tuvo una época de prosperidad llegando a ser en 1876 la cabecera del Distrito Norte de la Península; hoy, como mineral está abandonado enteramente y en la época de nuestra visita ni un solo gambusino o prospectador existía por allí. Las minas hace tiempo que están en ruinas y no fué posible visitar ninguna sino solamente por el exterior. Los afloramientos cuarzosos tienen diferentes direcciones dominando la de 80° N. W. y 73° echado al N. E., arman en micaesquistos; su esquistosidad tiene una dirección general de 20° N. W. y echado de 63° S. W.

Al W. del arroyo de Real del Castillo se levanta la sierra occidental compuesta de rocas metamórficas donde se destacan algunos diques de rocas ígneas y aun algunos estratos de resistencia mayor que sus vecinos; existen varios diques de pegmatitas con 15° N. W. y 52° echado al S. W. de donde obtuvimos algunos fragmentos de turmalina con mica, feldespato y cuarzo.

Entre las obras de importancia hechas para la explotación del oro, está una zanja como de 6 kilómetros de largo que bajaba desde el rancho del Agua Caliente y donde se nos dijo el agua duraba desde diciembre hasta junio.

El Mineral de Jacalitos.—En Jacalitos ha habido algunos trabajos que sólo se han suspendido desde la revolución. En el campo de la mina Providencia vimos

una veta de cuarzo lechoso como de 3 m. de potencia con 16° N. W. y 70° echado al S. W., tenía agua abundante a una profundidad como de 15 m.; otra veta también de cuarzo al E. de la anterior, con 24° N. W. de dirección y 68° echado al S. W.. y otra veta al N. E. de las anteriores con llenamiento de cuarzo lechoso con algo de fierro; arman en mica-esquistos cuya esquistosidad tiene una dirección general al N. E. La veta principal tiene salbandas a sus respaldos.

Entre las dos primeras vetas existe una roca negra de grano fino (diabasa) que no se puede decir si es un dique. En este Mineral existen varios arrastres donde han beneficiado el oro en diferentes épocas.

Los placeres de Las Choyas y Buenavista hace tiempo que están abandonados; el oro se encuentra en acarreos de un espesor que varía de 1 m. a 3 m. que cubren a las pizarras.

En Buenavista existen vetas de cuarzo ferruginoso que arman en las pizarras; tienen una dirección general de 60° N. W. y echado variable al N. E.; probablemente de estas vetas proviene el oro de placer que se ha explotado en esos minerales.

El Mineral de Valladares.—Valladares es un Mineral que contiene oro de placer y de vetas. Sólo aquí sí existen unos buscadores de oro, pero en una situación bastante pobre, pues no tienen éxito en sus investigaciones. A este Mineral lo trataremos en artículo especial porque en nuestro concepto puede dar luz sobre el origen del oro en la región.

Minerales de fierro.

El Mineral de Rosarito.—En el camino recorrido por nosotros existen tres centros de criaderos de fierro importantes, Rosarito, Sausalito y Santa Ursula, pertenecientes los tres a la Sección de Rosario Al Sur de Rosarito existe una veta de una potencia como de 6 m. y de una longitud de más de 200 m. en la parte visible; además de otras vetas de menor importancia y una cantidad muy respetable de hematita en guijarros desde 3 cm. de diámetro hasta 60 y 80 cm.

El Mineral del Sausalito.—En Sausalito también existe el fierro en forma de vetas potentes que se destacan en varias centenas de metros y una cantidad enorme de hematita rodada que cubre una grande extensión.

El Mineral de Santa Ursula.—En Santa Ursula vimos nosotros el criadero más importante por la cantidad de fierro que contiene a la vista, también de una veta que se destaca en una extensión.

Los otros criaderos están cerca de un granito claro, en contacto con rocas metamórficas y cerca de unos poderosos diques de una roca ígnea verdosa muy ferruginosa.

El porvenir de estos criaderos de fierro está sujeto principalmente al precio del combustible y después a las vías de comunicación y al agua; pero pudiendo llegar barato el combustible las vías de comunicación y el agua serían problemas relativamente sencillos.

Minerales de cobre.

Los minerales de cobre conocidos, son relativamente muchos, pero todos están paralizados, ninguno se trabaja en la actualidad, y es imposible visitar el interior de las minas.

Nosotros tocamos los siguientes: El Chasco, en las faldas S. W. del cerro de San Miguel, Sausalito, La Víbora, La Alejandra, San Fernando, Santa Catarina, Julio César y Santa María.

En San Fernando existe una fundición que originó que se pusieran en movimiento, además de San Fernando, Santa Catarina, Sausalito y La Alejandra.

El porvenir de todos estos criaderos está en obtener el combustible barato.

El que han usado en las anteriores épocas ha sido el combustible vegetal que se ha podido obtener de las cercanías, pero es poco y sale algo caro.

Composición de las Escorias Plomosas

La composición química de las escorias producidas en la fundición del plomo ha sido siempre considerada como de importancia. En años recientes no obstante las miras de los metalurgistas han sido considerablemente modificadas según dice el Sr. Irving A. Palmes, en su artículo "Fundición de los minerales Plomosos en alto horno" publicado en el Boletín de la A. I. M. E. de Julio de 1914.

La experiencia ha demostrado que muchas de las irregularidades del trabajo de los hornos que antes se pensaba se debían a la composición de la escoria, son el resultado de otras causas. Los trabajos del laboratorio han traído estas luces sobre la constitución de la escoria plomosa.

Ahora se sabe que esas escorias en lugar de ser de composición química definida son en realidad mezclas de un número de compuestos y óxidos los cuales probablemente existen en un estado distinto al estar fundido al que conservaban cuando estaban en estado sólido. Esos compuestos pueden existir en un gran número de proporciones sin cambiar materialmente la fusibilidad o fluidez de la escoria. También se ha reconocido que cietros óxidos tales como los del aluminio y del zinc pueden no estar combinados con la sílica en absoluto, pero pueden ser una solución ignea en la escoria.

Con hornos más grandes y los métodos modernos de preparar la carga actualmente en uso se pueden producir escorias más calientes que antes. .De esto se ha derivado el empleo actualmente de las escorias consideradas antes como refractarias para los trabajos de los hornos de plomo. En aquellos lugares en donde existe un excedente de minerales siliceos, el metalurgista preparará una escoria del alto contenido siliceo de manera de fundir mayor cantidad del mineral que contenga en más abundancia.

Por lo regular también él usa tanta cal como es posible por razón de ser un flux más barato que el hierro. Por supuesto, generalmente se tienen como más favorables a la metalurgia las escorias calizas en alto grado. A este respecto puede decirse que las escorias ricas en cal están más en uso ahora que antes. La idea antigua de que los óxidos de hierro y cal deberían existir en las escorias en ciertas y determinadas proporciones moleculares ha sido abandonada por la mayor parte de los metalurgistas. Esta llamada teoría "tipo" fué sostenida por largo tiempo y aun considerada por algunos como esencial. La teoría y la práctica se han combinado no obstante para indicar que las consideraciones que deben hacerse al adicionar cal a la carga, es sólo la cuestión de costo y porcentaje de sílice, alúmina, zinc y magnesia contenida más bien que el radio de la cal al fierro. Las escorias de plomo están ahora haciéndose por lo regular con un contenido de 35 a 37 por 100 de sílice y de 24 por 100 de cal incluyendo los óxidos de bario y magnesio considerados como cal. En estas escorias generalmente el zinc y la alúmina existen en bajas proporciones.

Las escorias ricas en sílica usualmente se les considera como fáciles de contener un porcentaje mayor de plomo. Hasta cierto punto esto es cierto, porque esta escoria corre bien, se enfría lentamente y conserva el horno en buenas condiciones. El acrecentamiento del horno es siempre básico y las cargas altamente básicas impiden su formación y son susceptibles de grandes trabajos.

A Chile, como a la Atenas de la antigüedad, le es dado hoy deducir de sus minas los ingresos que le son necesarios, en vez de obtenerlos por gravámenes impuestos a los ciudadanos. Según es bien sabido, las minas de Lario sostenían la flota destinada por Grecia para mantener su independencia. También Chile tiene hoy su escuadra, y, felizmente, no le es preciso invertir todas sus rentas públicas en el sostenimiento de ella. Gran parte de lo que producen sus yacimientos de nitrato, queda libre para emplearse en vías férreas y en el fomento de empresas que significan prosperidad para el país. Puesto que tan considerable parte de la riqueza pública queda, según se ve, invertida en forma productiva para el país, no correrá éste el riesgo de confrontar una crisis, cuando tales yacimientos se agoten, tal como acacciera en el Perú, cuando sus existencias de guano vinieron a menos.

Consideraciones Generales Concernientes a la Lixiviación del Cobre.

A la simple vista se verá que el problema exige sencillez y las operaciones deberán ser en grande escala. Respecto a que el mineral deba ser tomado al agua o el agua al mineral es un factor que debe considerarse y dependerá hasta cierto punto del sistema de tratamiento adoptado cuando el flete y combustible sea calculado.

Los métodos de lixiviación con soluciones de sales reductibles como el sulfato férrico, cloruro férrico y cúprico tienen alguna ventaja en su potencia solvente en la cuprita y chalcocita u otros sulfuros intermediarios, pero tienen una acción muy insignificante en la chalcopirita. Estas sales son costosas y su valor somo solventes comerciales depende de su regeneración por medio de algún método barato de oxidación después de que el cobre disuelto ha sido precipitado. Esta dificultad aún no se allana así como tampoco aquellas de los procedimientos del ácido sulfuroso y del amoniaco.

Sin embargo, dos métodos eficaces son practicables. Uno de esos es el antiguo procedimiento de Henderson de tostar con sal y el otro consiste en lixiviar el mineral en bruto con ácido sulfúrico. En el primero se incluye la llamada torrificación sulfatada de Wedge y la modificación en uso en Anaconda.

Brevemente se puede hacer una comparación entre las dos como sigue. Con el tostado de clorinación todos los minerales pueden ser tratados por el mismo procedimiento; y esto significará la construcción de una sola planta. El promedio de extracción del cobre probablemente sería más alto que con la lixiviación ácida y las pequeñas cantidades de plata contenidas en el mineral serían extraídas con mayor facilidad. Mezclando a los minerales muy poco azufre tendría que agregárseles en caso de tener que hacerlo algunos como la pirita. Las únicas substancias químicas que se necesitarían sería la sal en una cantidad que variaría del 5 al 10 por ciento del mineral tratado y probablemente una pequeña cantidad de mineral piritoso. De allí que habría menos soluciones corrosivas que manejar y una cantidad mínima de hierro y alúmina pasando a la solución y tampoco existiría una cantidad apreciable de cobre absorbida por las lamas.

Por otra parte, este método requeriría una trituración en seco del mineral de 20 a 40 mallas lo cual dificultaría, si no lo impedía por completo el tratamiento de minerales oxidados por razón de las dificultades para controlar los polvos venenosos aparte del costo del molido. Esto significaría un costo de torrificación. Significaría también una planta más costosa y más grande para la misma capacidad debido a la percolación más lenta del material fino. Se necesitará también de un abastecimiento de sal barata y además probablemente tendría que usarse un precipitante químico para recoger el cobre.

Lixiviando con ácido sulfúrico el mineral oxidado puede ser tratado en bruto y no necesitaría ser quebrado a un tamaño menor de media pulgada o a 2 mallas. El ácido sulfúrico puede hacerse como un producto secundario en una planta de torrificación o si el calcinado es convertido en fierro esponjoso y usado como un precipitante para el cobre, la pirita de baja ley puede ser transportada económicamente y fabricado el ácido en la mina.

Por otra parte, el ácido sulfúrico sólo, no extraerá nada del cobre existente en forma de sulfuro, sino solo la mitad del cobre existente en la forma de cuprita y podrá ser indiferente con respecto al silicato de cobre, no extrayendo tampoco ninguno de los metales preciosos. Mucho hierro y alúmina pasa a la solución como el cobre, lo cual estorba seriamente a cualquier forma de precipitación electrolítica haciendo que la cantidad de ácido regenerado sea de un valor dudoso comparado con la cantidad consumida. Como una compensación a esta objeción parte del fierro está en estado férrico, lo cual ayuda eficazmente a la solución de los minerales arriba mencionados.

Si el ácido fuere fabricado en otro luegar que no fuere en la misma planta de lixiviar, éste tendrá que ser transportado en carros-tanques, los cuales tendrán que regresarse vacíos. Si el ácido es hecho en la misma pirita de baja ley se economizarán los gastos de transporte, pero el costo de la erección de una planta para ese objeto se tendría que agregar al valor de la planta de lixiviar y tendría que utilizarse el calcinado. Casi tendría que construirse una planta enteramente nueva para el tratamiento de los minerales sulfurosos intermediarios. El problema es simplemente aritmético y metalúrgico.

En todos los casos en que hay que rascar cojinetes, se han servido hasta el presente del mimio de plomo o azul de Prusia para indicar los puntos altos. De los dos, el azul de Prusia es preferible, porque su textura es más fina que la del mimio de plomo, y porque permite un trabajo más suave. Su mezcla con el aceite es hecha del mismo modo que con el mimio, y su aplicación es idéntica.

Horno para la Fundición del Cianuro.

Las siguientes notas las damos en la creencia de que serán de interés para los operadores de pequeñas plantas de cianuración, en las que la instalación de una planta costosa no es de prácticos resultados.

El horno que se va a describir está bien adaptado al procedimiento de fundición de plomo Taverner el cual ha sido usado con muy buen éxito durante algunos años por el que esto escribe. Mi último horno fué usado durante cerca de cuatro años y fué construído en un cuerpo de carro de veinticuatro por cuarenta y dos pulgadas habiendo sido reemplazada la obra de ladrillo cada doce meses.

Para proporcionar el mejoramiento del volteo coloqué dos piezas de madera de 12 por 12 pulgadas por cuatro pies de largo paralelas entre sí y media pulgada fuera de cada lado del carro; luego a través de esas piezas de madera y a dos pulgadas del extremo posterior del cuerpo del carro se colocó un riel T de 16 libras de 48 pulgadas de largo para que descansara el extremo posterior del horno.

Luego pasando un pedazo de acero de perforar de ⅞ de pulgada a través de las orejas del fondo del cuerpo del carro pude obtener el mejoramiento del volteo. Para el horno propiamente dicho se colocaron dos sólidas ringleras de ladrillo refractario en el fondo, luego una fila al rededor de manera de dejar un espacio interior de 14 por 27 pulgadas dejando el flujo al extremo del frente del cuerpo del carro. Con esto se hizo espacio para la copelación o prueba, el cual se hizo cóncavo y ligeramente más abajo en el extremo posterior dejando así un derrame más estrecho antes del vertido final. La hilera próxima de ladrillo fué dejada con una abertura de 2 un cuarto y media pulgadas, es decir el espacio de medio ladrillo en el centro del extremo del anterior. Esto constituye el agujero de salida el cual se tapó antes de principiar la fundición con una mezcla de barro refractario y arena. Dos hileras más de ladrillos ponen el horno a la abertura del quemador en el extremo del frente.

La abertura del quemador fué hecha de manera de echar la flama a la carga a un ángulo de cuarenta y cinco grados. Sobre el horno por 18 pulgadas del extremo del frente coloqué un arco bajo de ladrillo refractario. Para la puerta de la carga se usaron tres ladrillos refractarios sugetos con un cincho de fierro teniendo un gancho al cual se aplicó una cadena que giraba sobre una polea para bajar y subir la puerta.

En el respaldo al último cuarton de madera se le hizo una perforación de 2 un cuarto por cuatro y media pulgadas dentro de la cámara del polvo ha

biéndose hecho el enladrillado del resto del espacio del cuerpo del carro cubriéndolo por encima dejando sólo una abertura en la parte superior para el escape de los gases. El volteo fué hecho con un nivel aplicado a la manija del carro. Después de llenar al rededor con arena y de sugetar entre sí los costados por medio de una varilla pasada a través de las orejas de la puerta, habiendo sido previamente separada, el horno quedó listo.

Se usó un quemador Caso de dos y media pulgadas. Cuando deseaba fundir se introducía la copela principiándose con fuego lento en la tarde dejándose enfriar hasta la mañana siguiente. El horno fué cargado con cerca de 100 libras de precipitado, litargirio y flujo habiéndose usado como 70 libros de flujo húmedo y luego se prendió el horno. Como esto se fundió se le agregó más con una pala hasta hacer una capa de material fundido de 7 pulgadas en el horno. Después de revolver y cuando la escoria estaba fluida la primera parte de esta se extrajo.

La Seguridad de los Crisoles.

Ni aún estando nuevos los crisoles de grafito son fuertes, y como es natural, una vez puestos en uso, van haciéndose más y más débiles. Sin embargo, la habilidad y el cuidado pueden lograr que, para la fundición de metales, sean relativamente gruesos. Debe examinárseles escrupulosamente, a fin de descubrir cualquier rotura o grieta que puedan presentar; sólo aquellos que estén en perfecto buen estado han de seleccionarse para el uso. Es preciso tener especial cuidado de que no estén húmedos. Si las condiciones en que se hallen el empaque o el vehículo en que se les haya transportado indican que los crisoles se mojaron durante el tránsito, debe, o devolvérseles al fabricante, o, si se usan, tomar con ellos especiales precauciones. La humedad en los crisoles constituye un verdadero peligro, porque cuando se les somete a temperaturas muy altas, el agua aprisionada en ellos se convierte en vapor, y éste, falto un rápido escape, causa pequeñas explosiones en las paredes del crisol, las cuales lo debilitan o lo rompen. La manera de remediar esto es calentar el crisol gradualmente, para quitarle toda humedad, antes de cargarlo, y mantenerlo luego de modo que no puedan ocurrir nuevas absorciones. Los crisoles deben almacenarse en sitios perfectamente secos, y donde la temperatura no sea muy baja. Si ello fuera posible, lo más acertado es colocarlos sobre la parte superior de un horno que esté permanentemente prendido. Si éste se sostiene a 250 grados Fhr., los crisoles estarán a salvo de todo riesgo, pues a tal temperatura no absorben humedad alguna. Para este fin, conviene tener aquéllos en contacto con los gases que se salen de los hornos; pero cuando éstos sean húmedos debe hacerse que hallen escape por las paredes, en vez de salir por la parte superior y afectar los crisoles. Debe evitarse el uso de cualquier combustible que contenga demasiada humedad, tanto en los hornos acumuladores como en los de fundición.

El Desarrollo del Procedimiento de Cianuración.

No hace mucho tiempo aún que el procedimiento de cianuración se creía que estaba limitado su uso económicamente sólo a un número muy corto de minerales. En su principio aquellos minerales que contenían oro libre finamente dividido se creía que earn los únicos favorables a ese procedimiento, pero no transcurrió mucho tiempo antes de que se extendiera a minerales más refractarios de oro y de plata los cuales hasta últimamente se creyó y durante mucho tiempo, que estaban excluidos de ser tratados por el procedimiento de cianuración, pensamiento o creencia abrigada aun por los más expertos en el beneficio o tratamiento de los minerales auríferos.

La cianuración está siendo aplicada al tratamiento de los minerales extremadamente complejos, siendo un ejemplo de esto la práctica de Cobalt, en donde han sido desarrollados métodos especiales para dterminadas necesidades.

No obstante esto, existen aun otros pasos que deben de tomarse con el objeto de ampliar el terreno o alcance de la cinuración.

Una plicación especialmente interesante es aquella de ciertos minerales de oro o plata que contienen pequeñas cantidades de cobre zinc o plomo o todos estos elementos, pero no en cantidad suficiente para ser de valor para su propia extracción, pero en su totalidad aumentan materialmente el valor de la producción si dichos elementos pudieran ser recogidos por medio de un sistema o procedimiento que fuere barato. No se han dado algunos pasos en este sentido con el objeto de resolver ese problema en la obra del Sr. D. Mosher y Bertrand Hunt, pero ellos aun no lo han aplicado prácticamente en grande escala. Parece cierto, sin embargo, que este desarrollo deberá ser perfecto algún día y con esto se aumentará notablemente el valor de la producción debida a la cianuración haciendo de valor muchos minerales que en la actualidad carecen de él por razón de su complejidad.

Algunas Indicaciones Prácticas para Roscar Agujeros y Conservar los Machos de las Terrajas.

Aunque todos los cerrajeros y los mecánicos saben manejar una terraja para roscar agujeros en una pieza metálica, nos permitiremos hacer algunas indicaciones sobre el particular, así como sobre el modo de afilar los machos, que creemos serán útiles para muchos. La divulgación de estas pequeñeces es, muchas veces, tanto o más importante que de cosas de mayor cuantía, porque, además de la perfección en los trabajos, permiten mayor rapidez y menos consumo de herramientas.

Las terrajas son, indudablemente las herramientas más indispensables para toda clase de construcciones metálicas, por lo que no creemos exagerar al concederles primordial importancia. Como es sabido, generalmente se compone el aparato porta-herramientas y de las herramientas propiamente dichas, las cuales se componen de unos cojinetes roscados, que sirven para hacer los tornillos, y de los llamados machos, que sirven para filetear las tuercas. Cada juego de machos se compone de tres piezas del mismo paso aunque algo distintas entre sí, que sirven sucesivamente, cuando la operación no se puede hacer toda de una vez.

En general, sólo se dedica alguna atención al aparato porta-herramientas, pero no a las herramientas propiamente dichas y menos a los machos. Estos, con el uso, se desgastan, las aristas se vuelven romas y cuesta mucho trabajo el filetear con ellos, haciéndose inservibles al poco tiempo. Entonces se liman por las caras gastadas para que vuelvan a quedar agudas las caras gastadas, afaldos los ángulos salientes. A los cortes del extremo se les habrá de dar la misma forma cónica que tenían de nuevos, pero se ha de tener cuidado de rebajar más la parte posterior para que corten mejor. El bisel debe rebajarse una cantidad que no llegue a un milímetro. Si los cortes se biselan demasiado, el macho oscilará al empezar el trabajo. Todo esto es aplicable a los tres machos que componen el juego de la terraja.

El agujero que se ha de roscar conviene que sea áspero en la boca, pues si está avellanado o rebajado, el macho penetra holgado y no se trabajabien.

Igualmente conviene no poner aceite al empezar el trabajo, sino una vez fijado ya el macho, por haber penetrado el grueso de un filete. Cuando se rosque una tuerca de metal basto, conviene dar media vuelta hacia atrás, de vez en cuando, para que se rompan las virutas que se hacen con la terraja.

Todas estas observaciones se refieren, principalmente, a las terrajas de mano, aunque algunas de ellas pueden aplicarse a las mecánicas.

Manera más Conveniente de producir el Acetileno.

Las múltiples ventajas que presenta el acetileno por su economía, su fácil producción y sus varias aplicaciones, ha desencadenado la inventiva de infinidad de personas más o menos competentes que han imaginado múltiples aparatos para su fácil generación.

No vamos a analizar uno por uno todos estos aparatos, porque, a más de no sernos conocidos todos ellos, dada su enorme variedad, resultaría una labor pesada y demasiado extensa, impropia, por lo tanto, de la índole y dimensiones de esta Revista. Unicamente trataremos de los tres tipos a que pueden reducirse todos los aparatos existentes, prescindiendo de detalles, y estudiaremos las ventajas e inconvenientes de cada uno.

Los tres tipos a que nos referimos, son:

Mezcla en conjunto del carburo con el agua.

Caída lenta del agua sobre el carburo, y

Caída lenta del carburo sobre el agua.

Como a sencillez, indudablemente el primero lo es más que todos porque se reduce a un depósito de agua provisto de un tabique en el medio que no llega al fondo, una de cuyas mitades está cerrada por la parte superior, si bien tiene un tubo que conduce el gas producido a la campana o gasómetro que lo almacena. Otro depósito en forma de cazo provisto de un mango largo, se llena de carburo y se introduce rápidamente dentro del depósito de agua, haciéndole pasar por debajo del tabique divisorio al departamento cerrado, en donde se combina, produciendo el gas acetileno, que por el tubo de escape antes mencionado pasa al gasómetro.

Sin embargo, este sistema tiene el inconveniente de exigir bastante espacio para su instalación, pues sólo para alimentar unos pocos mecheros se necesita un gasómetro de más de un metro cúbico de capacidad, a menos que se quiera estar cargando continuamente el aparato, cosa molesta y nada práctica.

Las ventajas de esta clase de aparatos son a más de la indicada sencillez, la de poder consumir en un momento dado todo el gas que se haya depositado en el gasómetro, el cual puede volverse a llenar en pocos minutos, sin dejar de suministrar gas a los mecheros.

Otar ventaja, también muy apreciable, es la de poder variar a voluntad, y entre ciertos límites, la presión de salida del gas, para lo cual basta aumentar o disminuir el peso de la campana por medio de contrapesos.

Como el depósito de agua en donde se produce el gas puede ser tan grande como convenga, y, por lo tanto, contener la cantidad de agua necesaria, ésta absorbe las calorías que se desarrollan en la generación del acetileno y la temperatura no excederá de la calculada.

El segundo sistema es el más empleado, aunque tenga muchos defectos, pues la facilidad de regular la entrada del agua, las pequeñas dimensiones de los aparatos, el poder prescindir en varios casos, de gasómetro o, en caso de tenerlo, ser éste de reducida capacidad, hace que estos tipos de aparatos sean los más generalizados, aunque no reunan las mejores condiciones técnicas, pues al verterse el agua gota a gota sobre el carburo, el calor tan grande que se desarrolla queda condensado en una pequeña masa cuya temperatura se eleva considerablemente, llegando a descomponer el acetileno en otros gases hidrocarburados que no reunen las cualidades del primero.

El Hormigón Armado.

Casi todos ya saben que el hormigón armado ofrece más resistencia que el acero u hormigón sólo. Un pilar de cemento con un diámetro de dos pulgadas, que vaya desde el piso hasta el techo, es fácil romperlo con un palo cualquiera. Una frágil barra de hierro, o aun de acero, es muy probable que no resista el golpe. Una pequeña cantidad de leña y un fósforo son capaces de destruir la utilidad de una barra del acero más fino.

Por el contrario, si alrededor de barras o alambres de acero se construyera una columna de hormigón de dos pulgadas de diámetro, el palo se romperá con el golpe y a la columna no le sucederá nada. El acero vibra cuando soporta algún peso, principalmente si está en movimiento, pero tal vibración queda reducida a un mínimo con la absorción del hormigón armado.

Esta no sería la explicación de un ingeniero respecto de este asunto; pero ella, sin embargo, sirve para dar una ligera idea. El hormigón armado ha hecho posible la construcción a prueba de fuego de los edificios rasca-cielos; en caso de fuego, el acero está defendido por el cemento. Cada uno de estos materiales posee distintas ventajas y diferentes elementos de resistencia, y al emplearlos juntos, forman una poderosa combinación, eliminando aquellos puntos débiles que muy a menudo es el caso con material de otras clases.

Según ya todos conocen, el hormigón lo preparan con arena, cascajo y cemento, en las proporciones que sean necesarias para el uso que vaya a hacerse.

Una idea de la importancia del hormigón simple y el hormigón armado en las obras de construcción en todas partes del mundo, podrá tenerse con el informe de que solamente en los Estados Unidos se fabrican todos los años cien millones de barriles de cemento.

Los grandes edificios los están construyendo con hormigón armado, y las estructuras más pequeñas, como residencias, garages e iglesias, de hormigón, o cemento u hormigón, ya en la forma de paredes macizas o bloques huecos.

En cuanto a diseños o estilos adoptados, hay un campo que no tiene límites; con los moldes de hierro o acero se ha hecho posible la producción de cualquier efecto artístico.

El hormigón armado entra principalmente en las construcciones de puentes, y las estructuras más fuertes y más hermosas han sido obras de las compañías de ferrocarriles. En dichas construcciones el hormigón armado absorbe la vibración y el acero les imparte la necesaria cantidad de elasticidad resistencia de tensión.

Fuerza y Durabilidad de la Cuerda Metálica.

El profesor G. Benoit acaba de verificar, en la Escuela Técnica de Karlsruhe, una serie de investigaciones, encaminadas a determinar la fuerza y la durabilidad de la cuerda metálica. He aquí, en resumen, los resultados que ellas dieron:

Los experimentos fueron verificados con un alambre de acero patentado, de 1 milímetro de diámetro, y de una resistencia nominal de 247,000 a 225,000 libras por pulgada cuadrada. Se le probó primero sólo y luego en una cuerda de siete hilos, la cual tenía un diámetro de 3.1 milim. y llevaba un corazón formado por un alambre más blando, cuya fuerza nominal era de 120,000 libras por pulgada cuadrada. La cuerda sometida a prueba soportó 1,770 libras. El corazón no se reventó, pero se estiró considerablemente.

Tanto las cuerdas como los alambres sólos fueron encorvados sobre una polea, en un ángulo de 90 grados y a razón de 1,000 vueltas por hora. Cada vuelta suponía el encorvamiento de la cuerda desde su posición recta, y luego el enderezamiento de ella. La tensión a que se les sometió en esta prueba fué de 11,200 libras por pulgada cuadrada. Los alambres sólos soportaron 108,710 vueltas; en las cuerdas trenzadas uno o dos hilos se reventaron antes de las 44,800 y de las 47,190 vueltas.

Para el primer experimento se usó una polea de seis pulgadas siete octavos de diámetro, la cual fué substituida luego por una de siete un octavo. En esta última el alambre sólo soportó de 122,000 a 200,000 vueltas. En el cable de tres hilos se reventó una después de las 40,860 vueltas. El de cinco cuerdas empezó a ceder después de las 35,000 vueltas, y se reventó de un todo a las 40,000. El resultado de dichos experimentos demuestra, como puede verse, que el alambre, especialmente si es de acero de alta clase, pierde con el trenzado de la cuerda una gran parte de su fuerza.

Purificación de las Aguas.

En todo caso cuando se va a llevar una agua a determinado punto, con fines domésticos, es necesario el tratar de obtenerla pura como ya se indicó y no permitir que en todo su curso; por causa alguna, pierda sus buenos caracteres; es absolutamente reporchable la conducta que permitiera una contaminación con la excusa de purificarla más tarde al hacer uso de ella; el Comité Consultivo de Higiene en Francia ya emitió y adoptó este principio: "Es preferible procurarse agua primitivamente pura que purificar agua sucia, por perfectos que sean los medios de que se disponga para hacerlo."

Sin embargo se presentan circunstancias en que es imposible tener agua primitivamente pura y entonces es necesario purificar la que no lo esté. En esta operación se procura quitar al agua las bacterias, muchas de las cuales son nocivas, y en segundo lugar la materia orgánica, bien sea porque sirva para la mayor pululación de los microbios o porque por sí sola pueda ser nociva para la salud por las toxinas que contenga. De una manera general se puede decir que el agua está bacteriológicamente pura cuando sólo contiene unas pocas decenes de bacterias por centímetro cúbico; rigurosamente aséptica es prácticamente imposible obtenerla para el consumo, únicamente por medio de complicados aparatos se puede obtener ésta, pero teniendo en cuenta el considerable número de bacterias que flotan en el aire, bien se comprende que poco tiempo después de salida de los esterilizadores se vuelve a infectar; además, si hay microbios patógenos también hay muchos inofensivos para el organismo y aun útiles porque le ayudan a digerir muchos principios que sin su ayuda serían indigestos (ej. la celulosa). Es posible que con el agua ingiramos algunos de ellos, y entonces el tomarla perfectamente estéril traería trastornos digestivos.

La purificación puede hacerse de varias maneras, filtración, tratamiento químico, eléctrico y calentamiento, pero antes de ocuparnos de ellos conviene explicar cómo se puede mejorar o preparar una agua para hacerla sufrir en seguida los procedimientos enunciados.

La clarificación consiste en separar del agua los cuerpos sólidos de un tamaño apreciable que floten o sean arrastrados; se consigue eso dejándola en reposo en un tanque un buen número de días realizando así lo que naturalmente pasa en los lagos, pero se le compromete su frescura porque se calienta demasiado. Haciéndola pasar por una serie de depósitos convenientemente dispuestos sale el agua en muy buen estado y lista para ser filtrada.

El alumbre mejora mucho el agua produciendo la precipitación de la arcilla y del carbonato de cal y arrastrando englobadas en una capa de alúmina la sustancia orgánica u organizada que el agua contenga. Los americanos, en los filtros así llamados lo usan como tratamiento previo.

La corrección química del agua sólo sirve para quitarle unas pocas sustancias que la hacen impropia para algunos usos, lavado, cocinado, etc., etc., por ejemplo deshacerse del sulfato y del carbonato de cal.

La destilación es un medio sólo usado en los buques.

Los filtros rápidos o filtros americanos son bastante prácticos y dan buen rendimiento de agua de buena calidad. Hay varios modelos fundados todos en el mismo principio. La filtración se hace bien sea bajo presión o bien con la sola presión que el agua ejerce sobre la capa filtrante; en el primer caso las paredes del filtro son de metal y el agua llega impulsada por bombas impelentes; en el segundo sus paredes pueden ser hasta de madera. En pirncipio se componen de un cilindro de doce pies de diámetro y veinte de altura en cuyo fondo se coloca una caja metálica, de fondo perforado, llena de arena fina que forma una capa de dos pies; en el eje del cilindro va un tallo metálico con una especie de rastrillo lateral en la parte que penetra dentro de la arena y sirve para revolver ésta; el fondo perforado de la caja metálica deja pasar el agua filtrada que se hace llegar luego al tanque de distribución por un pequeño canal. El agua llega por la parte superior, a veces previamente tratada por el alumbre, y se filtra en la capa de arena; cuando el filtro funciona muy lentamente al cabo de 24 o 48 horas es indicio de que la sustancia orgánica ya ha formado un magma demasiado espeso con la arena; basta entonces retirar con bombas el agua todavía no filtrada, invertir la corriente de agua filtrada de manera que atraviese la capa de arena de abajo para arriba y hacer girar el eje del rastrillo; se retira en seguida el agua del lavado del filtro y queda listo para volver a funcionar. Estos filtros son buenos, prácticos y poco costosos, se instalan en batería y las bombas, rastrillos, etc., etc., son accionados por un motor de vapor. El tenor microbiano disminuye el agua por ellos filtrada en un 98%.

Purificación local del agua.

Cuando por una circunstancia cualquiera es imposible proveerse de agua pura, bien porque los centros en donde se vive no se hace la conveniente distribución de este elemento de buena calidad, o porque lejos de ellos sea de forzosa necesidad consumir la que se consiga, aun que sea de mala calidad, hay que poner en práctica algunas medios que le hacen perder muchas de sus bacterias; los enumeraremos y con ellos iremos haciendo la crítica de sus ventajas y desventajas.

La ebullición.

Todas las bacterias perecen, si no están esporuladas, a una temperatura sostenida durante corto tiempo, media hora, de 100 grados. Unicamente quedan vivos algunos esporos de hongos pues las bacterias patógenas perecen muy rápidamente y se puede considerar prácticamente exento de contraer enfermedades de origen hídrico aquel que consuma agua hervida. Ha sido observado en varias guerras del Extremo Oriente que entre los soldados de esos países poco se desarrollan y propagan enfermedades epidémicas que en otros ejércitos hacen por sí solas más bajas que las balas enemigas; se atribuye al uso de la infusión de té en todos esos pueblos; el té por sí sólo no tiene más uso que darle aroma al agua que ha sido purificada por la ebullición a que ha sido sometida.

Después de la ebullición el agua pierde el aire que tenía en disolución, al que debía el buen sabor y otros propiedades organolépticas; por eso se observará el sabor desabrido que tiene tal agua; basta agitar frecuentemente para que ese mal desaparezca. El aseo debe ser riguroso en absoluto, en lo que se refiere a las vasijas en que se haga la operación y al punto donde se coloque el agua para que baje su temperatura; la menor transgresión a estas prácticas rigurosas hace que se pierda lo hecho, sobre todo si ya la temperatura ha bajado.

La filtración hecha al través de pastas de diferente composición, de barros cocidos y de piedras porosas es uno de los medios más comunmente puestos en práctica y si da buenos resultados sólo es en determinados casos en que han sido observadas las indicaciones aconsejadas.

No todo filtro es bueno por el sólo hecho de llevar ese nombre; hay algunos que sólo se pueden considerar como simples tamices, pues sólo interceptan el curso de las substancias más voluminosas que están en suspensión; otros siendo buenos por llenar todas las condiciones requeridas funcionan mal por el mal manejo.

Ya vimos cuáles eran los fenómenos que se pasaban en una filtración, a saber: separación de los elementos voluminosos que están en suspensión, atracción molecular en virtud de la cual los cuerpos pequeños que bien pudieran circular por los canalículos del filtro se adhieren a sus moléculas; eso es lo que pasa con los microbios, cambios químicos entre el agua y el filtro de los diversos componentes que lo constituyen. (Este es de poco importancia en esta clase de filtración, pasa lo mismo con la detención y separación de los elementos voluminosos porque se debe tener por costumbre no poner al filtro sino agua clara). La atracción molecular es el principio radical en esta filtración; las bacterias más voluminosas tienen apenas unos pocos milésimos de milímetro, la generalidad no pasa de dos, y entre ellas se cuentan las patógenas; un tamaño tan pequeño y los movimientos vivos de algunas de ellas harían poco eficaz la ac-

ción de los filtros que apenas por la pequeñez de sus poros trataran de deernetlas, por no dar ningún rendimiento serían poco prácticos y apenas en técnica bacteriológica se les utiliza; al contrario, circulando con lentitud y libremente por canales tortuosos las bacterias son atraídas por las moléculas a las cuales se adhieren sin poderse desprender, allí perecen y muy poco o nada se multiplican por la escasez de medios nutritivos que tiene el agua; las que logren artavesarlo son detenidas por la membrana viva que tenga el filtro en su superficie exterior.

Enumeraremos los principales filtros: el filtro de Chamberland compuesto de una bujía hueca de porcelana sin esmaltar encerrada en un tubo metálico que se adapta a ltubo del acueducto, el agua llega al espacio comprendido entre la bujía y su estuche, atraviesa la primera sufriendo la fitlración y sale al exterior por un orificio que continúa hacia afuera la cavidad interior de la bujía. Aplicables sólo en los puntos donde hay agua con presión; en los puntos donde falta esta condición se utilizan los mismos dispuestos en la forma llamada de "ménage:" dentro de un recipiente cualquiera se intorducen las bujías arregladas en serie, y por medio de un tubo de caucho adherido a lbotón hueco que comunica con la cavidad interior se hace la aspiración y luego sifón. La sola diferencia de presión en las ramas del sifón hace que se verifique la filtración. Estos filtros Chamberland dan agua buena, pero tienen la desventaja de que su rendimiento disminuye rápidamente debido a que los poros se obstruyen; se pueden regenerar por el calentamiento a 300 grados o por la inmersión prolongada en un baño de permanganato de potasa o de bsulfato de soda; son poco conocidos entre nosotros.

Los filtros de otars pastas, carbón amianto, porcelana, celusosa, poco usados, también tienen el mismo inconveniente de disminuir muy rápidamente su rendimiento. Igual cosa pasa a los filtros de arcilla fabricados entre nosotros, aunque dan agua buena en cuanto a pureza.

Los filtros más comunmente usados son los llamados "de piedra," tallados en un bloque de limo calcáreo endurecido, proveniente de los restos de varios g½neros y especies de foraminíferos particularmente "Globigerina" y "Robulina" (Carrasquilla). Purifican bastante bien el agua, si se observan algunas indicaciones: 1ª Conservarlos permanentemente con agua y que ésta se encuentre constantemente al mismo nivel porque si seca el filtro deja pasar el agua en seguida se le ponga inmediatamente sin que ésta sufra ninguna filtración; igual cosa pasa si se le eleva bruscamente el nivel; 2ª Cuando haya necesidad de limpiarlos se dejará perder la primera agua que filtre para no utilizar sino aquella que ya no arrastre restos de filtro; 3ª No se deben lavar con agua acidulada, como otros de arena, porque siendo su constitución calcárea se destruirán.

Diversas sustancias químicas tienen la propiedad de producir la oxidación, la precipitación u otros fenómenos similares de la sustancia orgánica y organizada contenida en el agua. El papel purificador de tales sustancias muy puesto en boga y preconizado en un principio, parece que no sea tan activo; a eso debemos agregar la acción que tales sustancias, no del todo desaparecidas del agua, pueden llegar a producir, si no casos de envenenamiento por su poca cantidad y toxicidad, sí trastornos irritativos del aparato digestivo. El permanganato de potasa figura a la cabeza de tales sustancias; agregándolo al agua en proporción de cinco a diez centigramos por litro de tal manera que subsista la coloración rosada, siquiera por media hora, se obtiene un precipitado oscuro de óxido de manganeso que arrastra consigo las impurezas; parte del oxígeno del permanganato ha sido puesto en libertad y va a oxidar la materia orgánica. Luego hay necesidad de hacer desaparecer el exceso de permanganato; aconsejan filtrar el agua por carbón o, más fácil, agregarle unas pocas gotas de jugo de limón. En pequeña escala se puede usar, pero es demasiado costoso en un campo más amplio. Unido al alumbre lo aconsejan a los ejércitos en marcha, para que los soldados puedan tomar una agua sucia en cualquier momento, haciéndole sufrir esta previa purificación.

El alumbre es más generalmente usado; como ya se vió, en algunos sistemas de filtración americanos, se hace por su medio la previa purificación del agua; aun las aguas de alcantarilla se tratan por tal sustancia. Como se sabe, el alumbre es una sal de alúmina y de potasa, cuando se le agrega agua con barbonato de calcio se forma ácido carbónico, sulfato de calcio, sulfato de potasio, e hidróxido de alúmina; el ácido carbónico se mezcla con e laire, los sulfatos se disuelven en el agua, e lhidróxido sólo se precipita en forma de copos que arrastran en su descenso las bacterias (si el agua no tiene en disolución carbonato de calcio se le puede agregar carbonato de sodio.)

El sulfato de cobre ha sido también propuesto para desembarazar el agua de bacterias patógenas: si bien tiene algún valor para esto, algunos higienistas condénan su uso a pesar de admitirle como un algacida de valor.

Durante algún tiempo estuvo en boga la purificación de las aguas por los derivados del cloro (cloruro de cal, hipoclorito de soda, peróxido de cloro) etc., etc

(Continuará)

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Organization of the American Society in Mexico.

The American Society of Mexico was organized in the capital city during the past month after a number of meetings held in the hall of the Y. M. C. A. and elsewhere. The object of the society is to look after the interests of all Ameircans in the republic, and is the outgrowth of a number of mass meetings in which unanimous opinions expressed by practically the whole American population were found to be surprisingly effective.

The new association is intended to voice the opinions, not only of all the Americans in the city but also of all those scattered throughout the republic.

The objects of the society as expressed in the articles of incorporation include; (a) To take cognizance of, and act upon, all subjects which may be of general interest to the society; (b) To promote and establish mutual cooperative relations among its members of a social, benevolent and other nature; (c) To cooperate with and assist other American institutions in Mexico; (d) To provide a home for the accomodation of its members, with all the privileges, advantages or requirments which may be deemed expedient or necessary.

The articles state that the society shall be of non-political, non-sectarian character, with no object of pecuniary profit. It has a president and the other usual officers, besides a council or board of directors which will meet at least once a month, and which may be called together in a variety of ways, among others upon the petition of three members of the board.

All citizens of the United States resident in Mexico are eligible to membership, either male or female, and provision is made for equal suffrage and the recall of officers who may prove undesirable for any reason. Applications for membership are to be made upon blanks furnished by the secretary and which must include the endorsement of two members and one member of the board of directors. This provision is not for the purpose of restricting the membership, but merely as a protection against adventurers who might, if membership were too easly acquired, use the name of the society for unworthy ends.

At the annual meeting the following officers were elected:—President, R. M. Raymond; vice-president, Sydney Ulfelder; secretary, J. Dudley Helm; treasurer, Sidney Conger; members of the board of directors, R. M. Raymond, J. D. Helm, Sidney Conger, Dr. S. Ulfelder, S. W. Rider, B. W. Wilson, Paul Hudson, Dr. P. W. Monroe, H. A. Kinehan, H. P. Lewis, and H. A. Basham.

There are a number of committes and more will be added when necessary. One of the more active is that on publicity, of which S. W. Rider is chairman.

Both the president, Mr. Raymond, and the secretary, Mr. Helm are mining men known throughout the republic, and it is desired that every American connected with the mining industry in Mexico shall be enrolled as a member of the society.

Anyone desiring further information about the American Society of Mexico may inquire at the office of the Mexican Mining Journal, No. 10 Lopez, or of J. Dudley Helm, secretary of the society, Mutual Building, Mexico, D. F.

A Cyanide Mill without Elevators.

Upon another page of the present issue we give a description of a cyanide mill which has not a single elevator or Frenier pump. All the transfer of pulp from a lower to a higher level is performed by means of air-lifts. Moreover, in nine months of operation there has been not the least trouble in keeping a steady and even flow of material through the mill. To one who has had first hand experience with the pulp elevator of the bucket type there would be little hesitation as to which he would prefer to operate, this air-lift mill or that other cyanide plant recently installed in this country and reported to have as many as twenty-seven elevators of the usual trouble- breeding kind.

To be sure, the conditions in this case are exceptionally favorable. The only material, except solution, that requires elevating is true slime. An exception is the short lift of the tube-mill discharge to the level of the feed of its own classifier. In most mills that would be a point of certain difficulty. Better practice would seem to be to employ the longer type of classifier and make the classifier do its own elevating. The usual tube-mill discharge is too coarse and contains too little moisture to permit of handling by air-lift. Fairly coarse sands, when well diluted, are not impossible in air-lifts nor in the Pachuca, but they require a considerable expenditure of air, and a momentary indiscretion on the part of the compressor will cause an immediate packing beyond the hope of recovery.

Theoretically the air-lift is not very efficient, but for all that its use may be the best of economy in the cyanide mill. It may be readily improvised and repaired in any plant. It has no moving parts, if properly installed and to do work suitable to its peculiar merits, it requires no care or attention, and it saves the first cost and repair bills of an elevator, which does demand much care and much attention. It is true that air under pressure must be provided, but no all-slime plant is without compressed air, and an additional air lift may involve the selection of a large size of compressor and consume some power but it would not increase the labor cost by a cent.

There is, however, another consideration which should be taken into account before deciding to make all transfers of true slimes by means of air-lifts, and that is that of the effect of aeration upon the mixture of ore and solution. The additional mechanical agitation due to the expanding air bubbles may improve and can scarcely hinder extraction, but the chemical action of the air, if not required, may be harmful. Unlimited aeration is not now considered good practice in all cases. It is now known that certain ores yield their values to cyanide solutions without any aeration or oxidation whatever, and unlimited air does increase the consumption of lime and in some cases also of cyanide. Besides the carbon dioxide always present in the atmosphere, air picks up more or less of this lime neutralizing compound in the compressor where some oxidation of lubricating oils is always going on.

The destruction of cyanide by the action of air has often been denied. It is true that a current of air may be passed through a solution of pure cyanide in distilled water for hours without any apparent reduction in its strength. But working mill solutions are not pure laboratory solutions. They contain substances that may act as oxygen carriers, and in testing there is frequently a marked difference in cyanide consumption when that of samples run in closed vessels is compared with the reduction of strength in aeration tests on the same samples.

In any case the use of air-lifts in this mill to the exclusion of all elevators is an indication of what may and will be done in the way of simplifying mill construction and the elimination of mechanical complications. The question of the secondary effects is only another added to the thousands of problems in cyaniding which still remain to be solved.

The American Society of Mexico.

The organization of the American Society of Mexico, which, it is hoped every American miner and millman in the republic will join, marks the beginning of a movement which must be of advantage to every American in the country and promises to exert a wide influence during the period of reconstruction which Mexico must enter sooner or later. It is not merely another association to be supported with light dues and pleasant social function. Nothing has as yet been said about dues, and it is to be hoped that there will be none. As far as pleasant functions are concerned, a Fourth of July celebration is promised and a club-house or home is among the plans.

But the objects of this association are much broader than the mere sharing of social pleasures. It aims to be the spokesman for every American in the republic, and the need of some authoritative body to voice the wishes and opinions of Americans here has long been apparent. Everybody knows how little effect the protest or petition of an individual American has had during the past three years. When a few days ago the Americans protested in mass, five hundred strong, the effect was instantaneous and surprising in its results. Those meetings once more illustrated the wisdom of the hoary old fable about the man who could not break a bundle of sticks over his knee but snapped them easily between finger and thumb when separated and taken singly. That is the purpose of the new society, to accumulate behind the individual the full weight of the entire member-

ship. The opinion of a single miner has little effect however forcefully it may be expressed. The society will increase the "punch" of that opinion a thousand fold.

It is in its advisory capacity that the society will probably do the most good, in bringing a combined knowledge and judgment to bear upon the improvement of conditions and making life in Mexico once more pleasant and profitable. In the past three years the Americans have lost many opportunities for advancing their own interests and those of the community, simply because they have had the American habit of expecting someone else to do it for them. They have now learned that if anything is to be done they must do it themselves. They have organized to do it.

The presence of the names of R. M. Raymond and J. D. Helm, among the list of officers is sufficient assurance that the mining interests will not be neglected, and that whatever the American Society of Mexico undertakes to do will be done or the "reason why" exposed to view.

Continuous Treatment for Sands.

The rapid increase of the use of the all-sliming system in hydrometallurgy, at the expense of leaching, is due as much to the difficulty and expense of handling sands on a large scale as to the increased extraction secured by fine grinding. The great first cost of a sand plant with its numerous tanks, settlers and the apparatus for charging and discharging and the expense involved in treating each tank charge as a separated operation, largely offsets the increased cost of grinding required in an all-slime plant. The simplicity of the all-slime plant with its continuous agitation, continuous decantation and filtration, have reduced the labor and supervision to such a point that it has become almost automatic. The continuous, uninterrupted flow of material from one end of the mill to the other where it is discharged, also continuously, as exhausted tailings, appeals to the mind as logical and orderly. And as crushing and grinding are receiving more thought and study the extra cost involved in reducing everything to minus 200 mesh will gradually decrease.

But it is obviously poor economy to give the ore this extra grinding, the cost of which must always be considerable, merely for the sake of convenience in handling, without some metallurgical advantage in the way of added extraction. It is well known that many ores and portions of others do not require fine grinding in order to release their values for economic extraction. Yet many of these ores are thus finely ground merely to escape the disadvantages of the sand plant. If there were some means of handling sands continuously and automatically and removing the values without recourse to the uncertain and unsatisfactory leaching process, it is certain that much of the readiness to provide power and machinery for fine grinding would disappear.

An interesting and suggestive experiment was carried out by the Butte-Duluth company in what may be called, for lack of a better term, continuous leaching. The ore was one containing slightly over two per cent copper and had been leached successfully in tanks with sulphuric acid. This ore was crushed to about 10-mesh and treated with the same solution in a series of classifiers, the treatment being continuous and fresh solution and wash water being applied precisely as in the case of continuous slime plants. The extraction was 89.9 per cent, 20 per cent more than by leaching, although the actual time of treatment was probably not more than 40 minutes. The power required for the treatment of 150 tons daily was only 4.6 horse power.

Old-time cyanide men, who are acustomed to think of leaching in tanks in terms of weeks instead of hours and days, will immediately shy at this short treatment. What good is a 40-minute treatment as applied to ores which do not yield more than 80 per cent of their values to two weeks' leaching? Perhaps it would not be sufficient, although this is by no means certain. But the time need not be limited to 40 minutes. A longer series of classifiiers, or machines longer in dimension and moving more slowly could be made to extend the time indefinitely. The influence of time on solution is very imperfectly understood. We know that it takes more time to dissolve a large partiticle than a smaller one because the outer metal must be removed before there can be contact between the solvent and the metal of the interior, and we know also that contact in a leaching tank is slow and uncertain, and that solution in cyanide is a poor way of recovering coarse gold. In the case of silver, its minerals are mostly so soft that coarse particles are not likely to be encountered in the cyanide plant. Time required for solution seems to depend upon the size of particle, contact and activity of solution.

The size of particles of soluble minerals being favorable, the time of solution can be greatly shortened by improving the contact with active solution. In this respect the classifier is far superior to the leaching tank, so far superior as to make continuous washing an economic possibility as a competitor of leaching. The classifier is only a descendant of the old "log-washer" used to remove clay and other material from lump iron ore and phosphate rock. It is said that before the invention of the log-washer it was the custom to wash iron ore by dumping it in a running stream of water, and that the log-washer accomplished in a few minutes what the running stream accomplished only imperfectly in days.

If the particle of gold or silver mineral is surrounded by quartz or other gangue mineral, and must be removed by slow diffusion of solution through cracks and crevisses, rapid solution is obviously impossible; but this is not a normal condition in free leaching ores. Contact favorable to solution seems to be best secured by providing free settlement of particles through solution. Violent agitation has been proved to be a waste of power. This condition, repeated free fall through solution, seems to be admirably provided by the classifiier, and it is not impossible that we may see in the near future this simple machine contesting the present supremacy of the stamp and the tube-mill.

Colonel Tepetate.

"What's this new dope they've got for knocking the mining game?" demanded the Pessimist.

"There isn't any new dope, "returned Colonel Tepetate only half interested. "Even in Solomon's day, there was no use looking for anything new."

"I mean this stuff about ore and depth."

"That's all right. Did you ever hear of a mine that didn't peter out sooner or later?"

"Of course not. But what is the use of digging up that now, when things are gloomy enough already. Why call attention now to the fact that ore comes only in bunches, with the best and biggest end of the vein near the surface?"

"No use that I can see. Human nature, I suppose. When the gloom is particularly thick somebody is sure to think of something to make the shadows still a little deeper. When a man is having a birthday party nobody remarks that life is but a fleeting show and leads but to the grave. They pull that sob stuff on him when he is down on his back wondering whether it will be worth while to stay and meet the doctor's bill. But I can't find anything to weep about in that best ore near the surface business. Think what it would be the other way around. Suppose you had to sink 5000 feet before it would pay to begin stoping. Besides, there are mines that pay at the depth of a mile. That is deep enough for me. Hoisting stuff a mile straight up is enough of a pull to satisfy anybody."

"But why did they do it?" insisted the Pessimist.

"You mean digging up that old skeleton when there isn't any feast on? I fail to see how that makes much difference. As I said before, human nature is like that. In hard times there is always some prophet snooping around telling the people that there is an end to all fun. In the old days they used to get sore and stone the prophets, and I've an idea that this particular prophet got his share of rocks too. I see that you're a bit sore yourself, and this Jeremiad wasn't aimed at you or me at all."

"It hits everybody in the mining business."

"Not at all! You and I and the most of us are not trying to sell stock on the old howl of 'richer ore lower down.' You and ninety-nine of the other fellows are not breaking your necks to dig down towards China. You are drifting sideways all you're worth because you're not extra fond of hoisting. As near as I make out this is about what happened:"

The old man took a look to see that his listener's attention was still with him. "As you know, there never was an ore deposit that made so much money for the stock jobbers as that on the Rand. Somebody got up a theory that the Rand mines were on an old gravel bed, one edge tipped up so that it comes to the surface. Some gravel beds are fairly uniform in values, and the Rand reef seemed to be that. The thing flattens out somewhat as it goes down, and what could be finer than a theory that a uniform bed of gold ore cut under a good stretch of southern Africa and stuck out into the ocean? Did you ever see a prettier layout for organising companies and selling stock?"

"I see! but how many years would they have to dig before finding out what they had?"

"Under the circumstances nobody kicked on that, and it gave more time for selling stock. The idea that the district which is sending so many millions to London and is helping to make our few dollars look so small, could keep it up practically forever, tickled everybody over there, as you can easily see that it would. Quite the most beautiful and most welcome theory that was ever hatched."

"And this prophet fellow came along and took a crack at that lovely theory! Yes, I can easily believe that there might be several cheerful optimists willing to shy a pebble at him."

"It was rather cruel of him, "ruminated the old man, always willing to look at the other side of a thing. "I can't think that he hurt it very much. It takes more than one prophet to sink a beautiful theory like that. England needs that gold, too. It's a heap easier to believe what you want to believe than something that you hope isn't so. Besides nobody has been down there, a mile or two underground, to see what the deposit looks like."

"So, he may be wrong, after all."

"In general he is right, of course. In particular, quien sabe. I am not in the prophet business."

"There's nothing in it."

"Nothing in what?"

"The prophet business."

"I never yet heard of one who tried to get anything out of it for himself."

"Then why do they do it?"

"They can't help it. A prophet is born that way. He just naturally has got to tell people that they are wrong, that they don't know what they are doing. It's his nature. He always picks out something that happens to be very popular at the time, and the result is that he never has many friends."

"He is a nuisance."

"I am not so sure of that. It is a good thing once in a while to show people how ridiculous they are, and to tip them out their hobbies. To be sure, the world never listens to its prophets. It heaves rock at them. But it may set a few to thinking. Anyway, the world has always had them and, I suppose, always will. The modern prophet has a rather tough time of it. He can't fall back on a miracle, like Daniel and Isaish used to do."

Como, Uplift!

The members of the schoolmasters' association will receive from 3 to 4 o'clock this afternoon their first lesson in the manufacture of explosives.

At 4 o'clock sharp the regular session of the society will begin and matters connected with the uplift of the community will be discussed.—**Mexican Herald.**

A silver-tin lode is being mined at the Aramayo Francke property in Bolivia. This peculiar ore is being shipped to England, but a lixiviation plant is to be erected to treat it locally.

La Lucha Cyanide Mill.

Written for the Mexican Mining Journal.

By T. E. Pratt

The stamp- mill and cyanide plant of La Compañia Minera La Lucha y Anexas, at Tlalpujahua, Michoacan, is not a large plant, but it was built and put into operation under circumstances so difficult and discouraging as to mark this as one of the most interesting enterprises of recent years. The contract for the construction of the plant was signed in August, 1913, at a time when most of the mining interests considered continuing operations almost hopeless and new construction impossible. Repeated interruptions of railway traffic caused unending delays in securing machinery and materials of construction, and prevented entirely the importation of certain materials usually considered essential. Yet within eleven months of the time of placing the contracts for the machinery, the mill was up and in successful operation. It was necessary to float a considerable loan to complete the construction. The stamps began to drop on July 5, 1914, and by the end of that same year the loan had been fully paid up, during a period when the "tuning" up process was so far from complete that not more than fifty per cent of the capacity planned could be obtained. During the first four months of operation the amount of ore milled was 4624 tons. The total operating expenses in the mine and mill, including development work, amounted to $88,096.51 and the value of the bullion obtained was $194,346.93, leaving a net profit of $106,250.42.

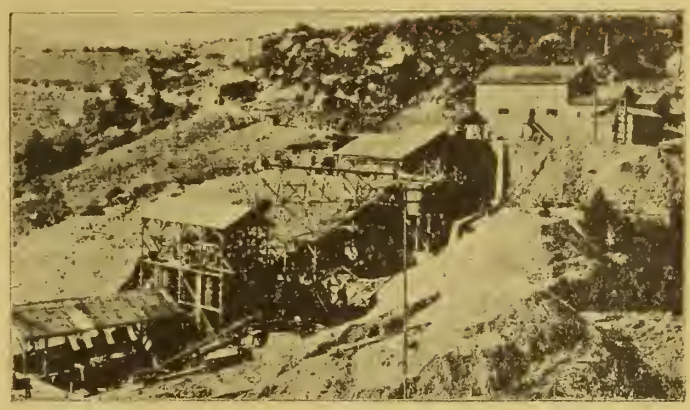
La Lucha Mine, Tlalpujahua, Mich.

Of course, these results are due only in a minor degree to the excellence of the plant. The mine is the determining factor in any mining enterprise. But if there had not been the enterprise to attack and overcome all obstacles, there would have been no mill, and if the mill had not been suitable there would have been no profits.

Crushing Plant.

The mill buildings are not elaborate, the character of the climate demanding little protection from the weather and the difficulty of securing materials making it imperative that this part of construction should be as simple as possible.

The ore from the mine is dumped over a steel-taper-



Mill of La Lucha Mining Co.

bar grizzley, 4 by 12 ft., with 1½ in. openings. The undersize goes directly to the battery bins while the oversize is further reduced in size by means of a Blake type Denver Engineering Works crusher, having a 9 by 16 in. opening, and driven by a 15 h. p., General Electric motor.

The ore bin gates are of the rack and pinion type with 18 by 24 in. opening.

Power is obtained from the lines of the Mexican Light & Power Co., with generating plant at Necaxa, Puebla. All motors run on three-phase, 50 cycle, 440-volt circuit.

The discharge from the crusher joins the undersize from the grizzly in the battery bin which has a capacity of 90 tons, whence it is fed by means of Challenge feeders of the "monkey grip" type into the mortars

There is a battery of ten stamps of 1250 lb. each. The mortars are of the narrow single- isssue rapid crushing type, furnished by the Denver Engineering Works, and rest directly on concrete foundation placed on bedrock. The cam-shaft is of hammered wrought iron and the cams have Canda self-tightening taper keys. The guides are of the Pacific sectional type, and the tappets, boss-heads, shoes and dies are of chrome "Adamantine" steel manufactured by the Chrome Steel works.

The battery posts are 12 by 26 in. 22 ft. long. Since it was impossible to obtain well seasoned timbers of these dimensions in the country and none could be imported, it was necessary to improvise. The situation was met by Mr. Glenn Anderson, the manager. Under the misgivings of "those higher up" he proceeded to construct built-up posts of selected one-inch planks. All surfaces were accurately planed and painted before assembling and the whole rigidly bolted. These built-up posts have now been in continuous use for nine months and show no signs of disintegration of any sort. Mr. Anderson's posts are bound to arouse a great deal of interest among the mining men of the country, for it is increasingly difficult to secure sound timber of the dimensions required by the modern heavy battery. The battery posts put into one of the more recent mills in this country were secured at a cost of $150 (gold) each, and they were not as free from checks and cracks as are those of La Lucha mill.

The stamp stems are of soft steel, and a 2-ton crawl

* Engineer with Victor M. Braschi Machinery Co. Inc.

with differential chain block aids in handling the stamps. Crimped wire battery screens of 6 mesh have hitherto been used, but it is intended to increase the size of discharge from the mortars to secure greater tonnage, as soon as other units in the plant have been up to rated capacity.

The battery is driven by a 35 h. p., General Electric motor, and the tension of the drive belt is regulated by a tightener of the swing type, with adjusting wheel, supplied by the Denver Engineering Works.

Regrinding.

The battery discharge, containing about three of solution to one of ore, flows through an open wooden launder, having a fall of 2½ in. to the foot, into a Belmont type, duplex Dorr classifier. The overflow from the classifier proceeds by gravity to the thickener, while the sludge enters the tube-mill for further reduction. The tube-mill is of the tire and trunnion type, 4 ft., 6 in. in diameter and 18 ft. long. El Oro liners are used and quartz from the mineral vein serves as pebbles. This quartz is really ore, so that the expense for pebbles is nil.

The tube-mill is driven by belt and pulley, the pulley, being 54 in. in diameter and 14 in. face. It is driven by a 50 h. p. Form M. G. E. motor which can take a 100 per cent overload for 2 minutes. It is fitted with a standard starting rheostat. The product of the tube mill is elevated to the classifier by means of an air-lift. There are no bucket elevators in the mill, all material being handled by pumps or air lift; pumps for clear solution, and airlifts for mixture of pulp and solution. The tube mill classifiers are operated in closed circuit, all oversize from the classifier returning to the mill and only finished pulp being discharged from both units.

The Cyanide Plant.

The slime overflow from the classifier flows by gravity into a 20 by 20 ft. Dorr thickener, the clear overflow from which is conducted into storage sump tanks of the mill, either that of the pregnant solution or the barren tank as the operation of the mill requires. This thickener has the standard fittings and is driven by a one horse power motor. The pulp is thickened to about 40 per cent slime, and is then elevated by air-lift to the Dorr agitators, two in number, each 16 ft. high and 16 ft. in diameter. The agitators are connected for continuous discharge; the time cycle being dependent upon the speed of crushing and the density of the pulp.

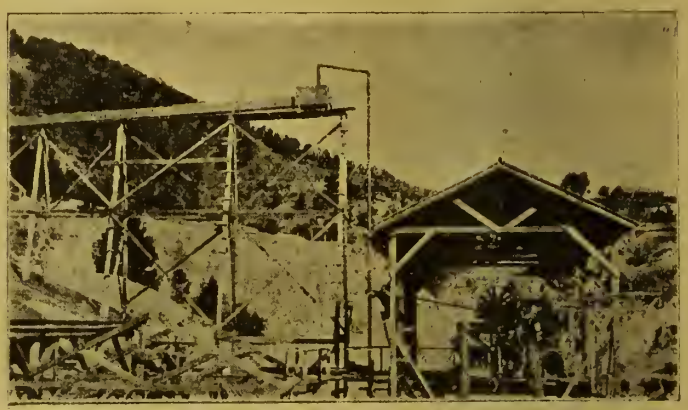
After agitation the pulp is elevated, again by air-lift, to a stock pulp tank where it is kept in suspension until required for the filtering plant. The pulp is held in suspension by means of standard thickener mechanism speeded to the point required. The agitators are driven by a 10-h. p. motor and the stock tank by a one horse-power unit, both of G. E. manufacture.

When the plant was designed and built the air lift for elevating the agitated pulp to the stock pulp tank of the column was arranged to rise through a vertical-pipe, because there was no definite available information as to whether an inclined pipe would work satisfactorily. This necessitated the construction of a trestle about 45 ft. high, at its highest point, to carry the discharge launder. Later experiments were made and it was found that the rising column could be inclined without affecting the efficiency of the air-lift, no elevated launder being necessary.

From the stock pulp tank the thickened and agitated pulp flows by gravity to a Merrill slime filter press, the head between the tank and press being so adjusted that the pressure is fairly constant at 30 lb. The filter press carries 25 frames, each 4 by 3 ft. and 3 in. thick. The wash water enters the filter at a pressure of 60 lb. The filtered solution flows into the rich solution storage tank, and the tailings are discharged into a dam where a good proportion of the sluicing water is recovered.

The sump tanks for both pregnant and barren solution are of masonry, 20 by 24 ft. and 8 ft. deep. Masonry tanks with a concrete lining are economical in many parts of Mexico in the matter of first cost as well as repairs. Materials are usually abundant and the natives understand stonework perhaps better than other kinds of labor.

From the sump tank the pregnant solution is pumped to the clarifying tanks preparatory to precipitation. There are two of these tanks, each 12 ft. high and 12 ft. in diameter, and work through a bottom carrying 12 in. of washed sand.



Upper part of Tank and Siphon of La Lucha Mill.

The clarified solution is precipitated in four five-compartment zinc-boxes, 15 ft. long., 3 ft. wide and 2 ft. deep. The precipitation room is equipped with a steel tank for collecting the precipitate, a drying furnace and a melting furnace. The precipate is filtered in a Shriver press which is served by an Aldrich triplex pump with 3 by 4. in. plungers and a capacity of 25 gal. per minute against a pressure of 150 lb.

The melting furnace is for brick equipped to use fuel oil. Since this has been unobtainable, melting has hitherto been done with coke and charcoal.

The barren solution is pumped to the supply tank at the upper level of the mill. This tank is 12 ft. dia. by 12 ft. deep made of steel plate and feeds an 8 by 6 ft. constant level tank which insures a constant pressure at the batteries. The barren solution pump is an Aldrich triplex, vertical, 5 by 7 in. plunger pump with a capacity of 100 gal. against a lift of 175 ft. The rich solution pump is of the same type, but has 4 by 5 in. plungers and a capacity of 50 gal. per min. Both these pumps are equipped with tight and loose pulleys.

An Ingersoll-Rand, class N. E. 1, compressor supplies air for the agitators and air-lifts. It has a cylinder 12 in. diameter by 8 in. stroke with a piston displacement of 207 cu. ft. per minute at a speed of 200 r. p. m. This compressor is worked at a maximum pressure of 30 lb. and is fitted with an unloader or regulator in case the pressure rises above the desired point.

The two solution pumps and the compressor are driven by a 35 h. p. G. E. motor by means of a counter shaft. The precipitate pump has an individual motor of 5 h. p. capacity.

All water used about the mill comes from the mine pumps.

Plans and Construction.

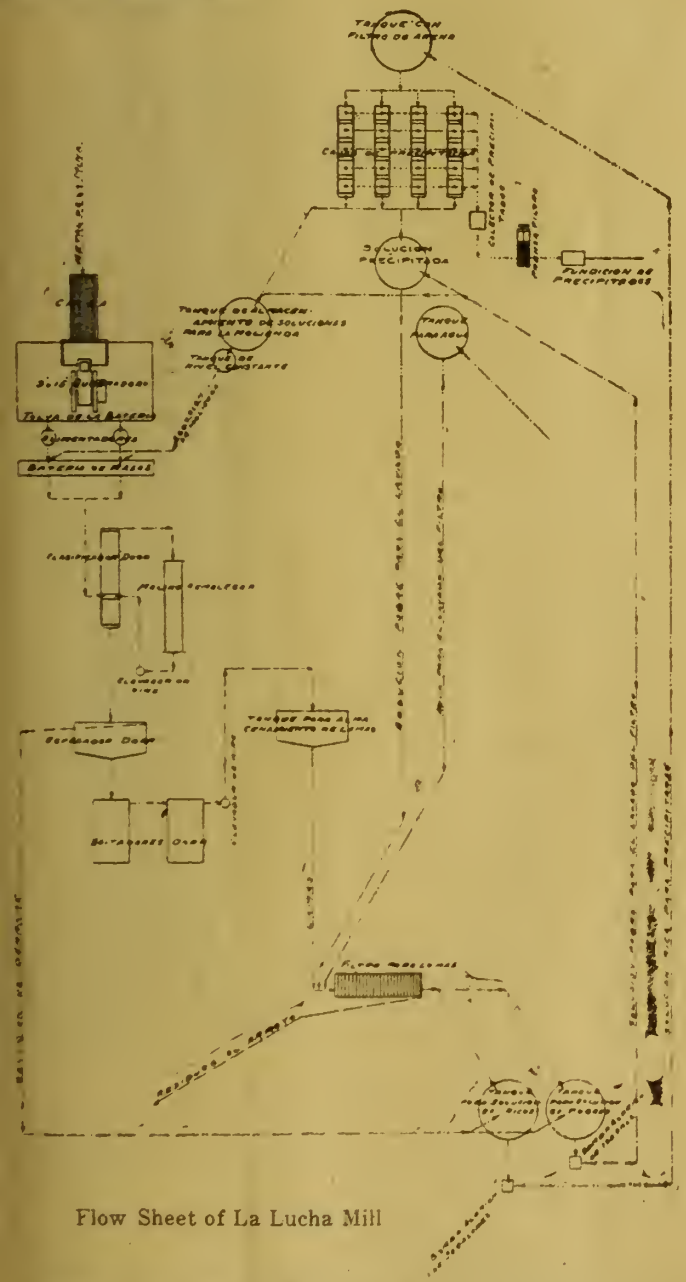
The preliminary plans and experiments for La Lucha cyanide mill were made by the firm of Grothe &

Carter some time ago. When it was definitely decided in the spring of 1913 to proceed with construction these plans were completed in detail under the supervision of T. E. Pratt, engineer for the Victor M. Braschi Machinery Co., which firm supplied all of the machinery.

No data as to the operation of the mill are as yet available, further than that a profit was realized the first month, and that the margin has steadily increased.

The ore is quartz carrying sulphides. The veins occur in andesite.

The sampling of lode No. 45, which is the main lode in the mine, showed an average of 180 grams of silver and 31.9 grams of gold. However, the richest ore carries 300 grams gold.



Flow Sheet of La Lucha Mill

There are three other lodes in the claims on which some development work has been done. These are the Temascales with an average width of one meter and content of one kilo of silver, the Remedios which has an average width of 1½ meters and from 1 to 15 grams of gold and the Ocotes has an average width of one meter, and it is unimportant as far as its present values are concerned.

The shaft is 137 meters deep and is equipped with a 45 single drum Denver Engineering Works hoist. The pumping equipment consists of an Aldrich vertical triplex pump with a 15 h. p. motor.

Vanadium Discovered by a Mexican.

In 1801 Andres Manuel del Rio, a professor of mineralogy in the Royal School of Mines of the City of Mexico, in examining some brown lead ores from the mines of Zimapan, Hidalgo, believed that he had discovered a new element different from chromium and uranium, and this he named eritronium. It was in reality what we now know as vanadium. The discovery was a genuine one, but unfortunately the professor was a little too much under the glamour of the French school, and when Collet Descostils published an article in which he stated that Del Rio's eritronium was nothing more than impure chromium Del Rio accepted the French professor's judgment and in 1804 disavowed his claim of discovery and admitted that the substance was a lead chromate. Subsequent events showed that Del Rio had been right and that the element does not even belong in the chromium group. It was not until 1830 that the Swedish scientist, N. G. Sefstrom, rediscovered the element among the slags of the Taberg iron ores and gave it the name of vanadium, a name probably derived from what might be termed a family name in Norse mythology, Vanir or Vana, to which group Freyja, the Norse Venus, belonged.

Vanadium is a silver white metal which readily oxidizes; it has an atomic weight of 51.2, is non-magnetic, has a very high electrical resistivity, and melts at about 1680° C. As an alloy of iron, however, its melting point is about 300° lower. It is one of the most widely disseminated elements, although commercially available deposits are comparatively rare. It has been found in several of the western states of the United States, in Sweden, Australia, Spain, England, Argentina, Chile, and in Peru. It is upon the last named country, however that the world's commercial supply depends. The asphaltite deposits from which the Peruvian vanadium is obtained are located at Yauli, Matucan, Casalapca, Huari, Huancayo, and last and largest, at Minas Ragra. The ore from the Ragra mines, which looks like a hard slaty coal, contains about 40 per cent vanadium sulphide, 30 per cent free sulphur, 14 per cent silicia, 4 per cent iron sulphide, etc., and after burning out the free sulphur the ore contains about 52 per cent vanadium oxide.

Until the recent development of vanadium in the steel industry its commercial use was largely confined to ink making and coloring fabrics and leather. The ink is made of a mixture of a neutral solution of amonium vanadate, gum water, and a solution of gallic acid. Neither acids nor alcalies can destroy it, nor can it be bleached out with chloride. About 1905 the supply of vanadium, owing to the development of the Minas Ragra and other mines in Peru, began to increase. From having been a rare metal, it became available in quantities claimed to be unlimited as a steel making metal. The claims of its users are that it has accomplished wonders in crucible and in open hearth steel, that it gives cast iron greater strength and endurance, and that copper and aluminun are remarkably improved for certain purposes by its addition. It is used in steel for engine axles and frames, in transmission shafts and gears, in wire springs, piston rods, hydraulic cylinders, tires, tools boiler plates, gun shields, projectiles, armor plates, gun barrels, watch springs, and in castings and forgings generally. One of the great advantages of the use of vanadium steel in the future will no doubt be in enabling the steel factors to reduce weight in such constructions as locomotives, cars, machinery, etc., its greater durability being another important feature.

The Holt-Dern Process.

Written for The Mexican Mining Journal.
By Clarence L. Larson. *

The successful operation of the plant of the Mines Operating Co., at Park City, Utah, during the past year, has drawn attention to a new type of chloridizing. This plant has been ably described by. T. P. Holt in the July, 1914, Bulletin of the A. I. M. E., and by F. Sommer Schmidt in the Mining & Scientific Press of Aug. 29, 1914. These articles give a very complete description of the plant equipment and operation, therefore in this paper will be presented but a brief summary of the method in use.

Method of Operation.

The ore being treated consists of low-grade fillings from old stopes and has run about as follows:— silver, 6 to 14 oz.; copper 05 to 10 percent; gold, 01 to 015 oz.; zinc and lead, up to 1 percent each; insolubles, about 80 percent sulphur, up to 1 percent; manganese, up to 1 percent; lime, about 1 percent; and iron, about 8 percent.

The mine-run ore is dried to about 5 percent moisture, and crushed to 1 in.; it is then intimately mixed in further crushing to ⅜ in. with 2½ to 3 percent of coal-dust and 7 percent salt. This mixture is then introduced into a shaft furnace of either intermittent or continuous types (these will be considered later); suitably ignited at the bottom, and roasted by the forcing up through the charge of a positive air-blast.

The discharged calcines are sluiced with mill-solution to tanks and leached. The leach solution is a hot brine, 20 deg. Baumé, acidified with about ½ percent of sulphuric acid. The loaded solution is passed over scrap copper on which precipitates the contained silver, and then through iron boxes. The first of a long series of these boxes, catches fine copper, while the lower boxes produce a copper-lead product. From 90 to 95 percent of the silver and copper are extracted by the process as outlined, and about 50 percent of the gold. Should the values be sufficient to warrant the addition of bleach to the pulp as it is sluiced into the leaching tanks, over 90 percent of the gold may be recovered.

Distinctive Features.

Dry chloridizing of metals, by means of chloridizing roast, preparatory to subsequent lixiviation, is not of recent origin. In the latter part of the 1830 's Longmaid employed in England such a roast in reverberatories, for the recovery of copper and by-products from cupriferous pyrites. Since then the use of chloridizing has spread rapidly and has been widely used in the treatment of silver and copper ores and products. Attempts on other metals have also not been wanting. Such development has not, however, utilized the type of roasting or the type of roasting apparatus advanced by the Holt-Dern process.

The new feature in this process is the intimate mixture of moist ore, coal-dust and salt, followed by roasting with the internal combustion of the fuel in the charge supported by a positive air-blast; the roasting being accomplished in a shaft type of furnace.

U. S. Letters patent (1,107,240) have been granted the process. A brief abstract of the claims made therein follows:

The patent claims rights to the general process of roasting as described above, including the use of salt under the claim of the use of chemicals in the intimate mixture of coal and crushed ore, as a permissible and not essential part of the process. Plant admits previous use of a mixture of chemicals with ore, but claims as a new step the addition of fuel in the mixture. Moisture enters the chemical reactions as well as aiding in the formation of a leachable product and in the prevention of dusting.

The patent specification states that the presence of fuel in the ore eliminates the addition of fuel to the mixture. Fuels included under the rights claimed are coal-dust, crushed pyrite, saw-dust, charcoal, crude-oil, etc. If desired, steam, gaseous or vaporized chemicals may be introduced with the air-blast. Control of temperature is secured by regulation of the air-blast. The use of any suitable roasting apparatus is permissible within the rights claimed. The final step in process is lixiviation with a suitable solvent.

The secondary process claimed under this patent includes claims as follows: the removal of calcines from below the roasting zone; the addition of more charge above the roasting zone; the maintenance of proper depth below the zone so that the material at the discharge point is at a temperature slightly above that of the initial air-blast; the maintenance of proper depth of fresh ore above the zone so as to cool the gases and condense volatile metals (the last two features embrace a design to secure the maximum heat efficiency).

Claims of special application of the process are as follows: preparation of gold ores for cyanide treatment, i. e., carbonaceous material, ferrous salt, tellurides, gold locked up mechanically in sulphides; the chloridizing preparation of silver ores preparatory to cyanidation, hyposulphite of other lixiviation processes; the chloridizing, sulphatizing and oxidizing of copper ores preparatory to lixiviation.

Claim is also included for the condensation of furnace gases into liquor to be used in the lyxiviation work following the roasting.

It may be noted in the abstract of the patent claims that the new features advanced are assigned a rather wide field of application. Commercial adaptation to date has been limited to the chloridization, as already described, for the recovery of silver, copper and gold values.

Holt-Dern Furnaces.

Inasmuch as the type of furnaces in use are a considerable part of the new features in the process, brief descriptions are pertinent. Fig. 1 is a front to back section of the intermittent type of furnace being used. It is 10 by 10 ft. inside dimensions, having reinforced concrete walls 10 in. thick. About 2 ft. above the bottom is placed a grating of wood supporting a layer of coarsely crushed rock. The space below the grate serves as an air-pressure equalizing chamber, allowing the grate to distribute uniformly the air rising through the charge:

Upon the gravel floor of the roaster is spread an igniting layer of coal-dust mixed with oil. Upon this is spread about one ton of a special "mix" of charge, which consists of a regular charge with extra coal and salt added. Air blast is turned on and this aids the coals to ignite the fuel in the special mix layer. When this layer has roasted through, the air is shut off for

* Salt Lake City, Utah.

a few minutes while a first charge of about 5 tons is dropped into the roaster. This is spread out and the air again turned on. Upon the appearance of the fire at the top of this layer a second charge of about 10 tons is dropped on, and a few hours later a final charge of about 10 tons. This brings the total depth of charge up to about 7 ft. and this depth normally roasts through in 8 to 12 hours. When the roasting zone has reached the surface at all points the blast is turned off, the sluicing is opened, a sluicing apron inserted and the hot calcines sluiced out into launders leading to the leaching tanks. One to three hours are required for sluicing a 24 ton charge.

The Holt-Dern continuous roasting furnace has been developed as a result of the experiences with the intermittent furnaces as have been just described. The Continuous furnace is truly continuous as to its roasting, but its charging and discharging are intermittent. U. S. patents 1,113,961 and 1,113,962 cover this type of furnace. Fig. 2 is a sketch elevation and Fig. 3 a sketch plant at the grates of the furnace covered by the first patent.

In the illustration the charge roasting chamber (1) has a refractory lining for heat conservation and protection of the shell from corrosive gases. An air-tight cover is provided for the admission of charge. The flue (2) leads from the roaster to the condensing chambers. The lining is smoothly finished and its size increases slightly, that is, in internal diameter, towards the bottom. This is to effect a uniform settlement of the charge during discharging operations. A grate (3) consists of four sections of bars or rakes transverse to the direction of the reciprocating motion of the sections. This motion is secured by the respective connecting rods driving from eccentrics (4) operating on a line shaft which is geared to a suitable driving shaft (5) The grate bars have teeth-projections capable of scraping or crushing the exposed bottom face of the calcined charge. This motion of the grate sections is intermittent and corresponds to the periods of discharge. Alternate eccentrics are set at 180 deg. so that contiguous sections travel in opposite directions. This is done in order to avoid unequal strains on the shell of the furnace and to avoid the formation of air channels up the sides of the furnace. The grates are supported, as shown at (6) by rollers resting on supporting blocks held between channels.

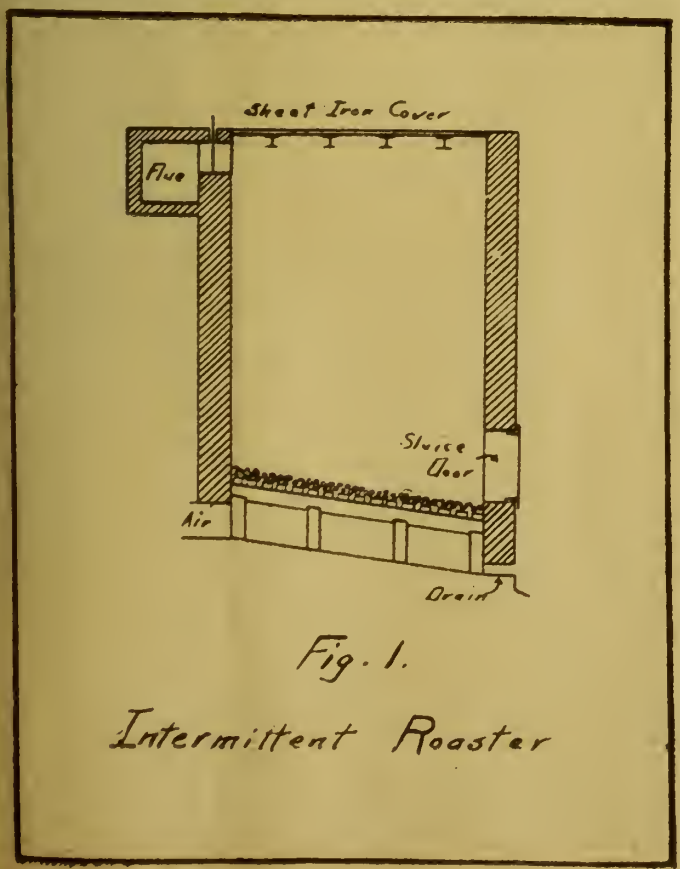


Fig. 1.

Intermittent Roaster

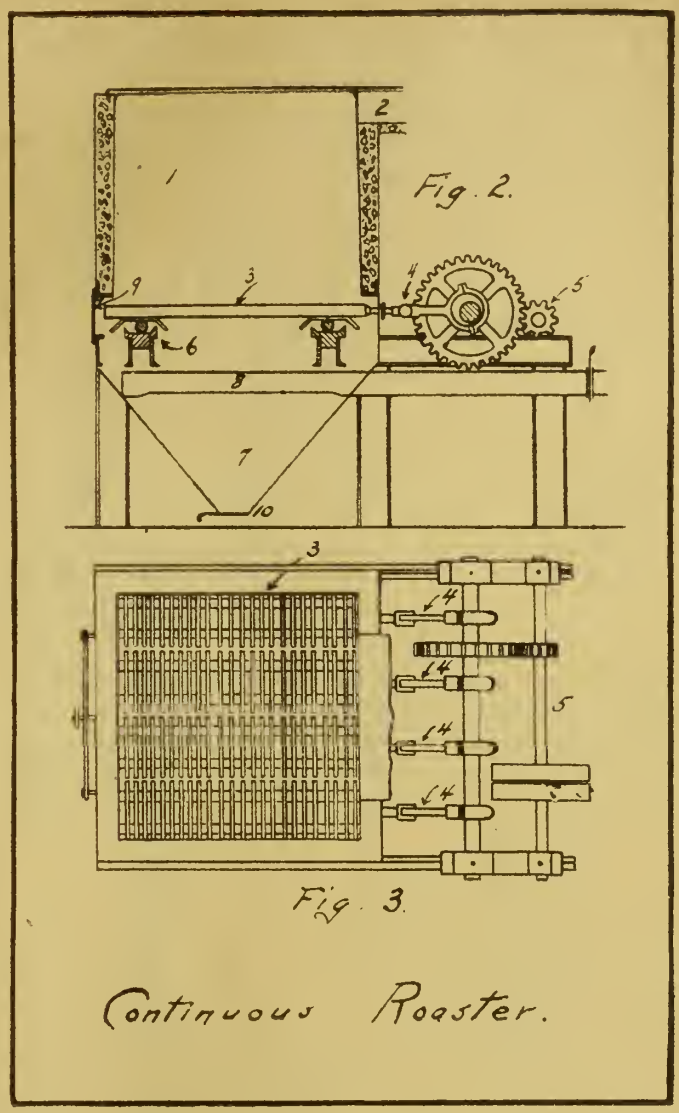


Fig. 2.

Fig. 3.

Continuous Roaster.

The air-blast enters through perforations in the under side of (8) into the air-equalizing chamber (7) An air-tight door (9) is provided for grate inspection purposes. The chamber also serves as a hopper for the calcines scraped down by the grates at the intermittent periods of discharge. This hopper empties through the gate (10) into a car or launder, or on a conveyor belt.

Thus is indicated the continuous roasting of charge in column form, with intermittent charge feed on the top of the column and a discharge of completed calcines from the bottom. With air-blast and heated gases passing upwards it may be noted that the system of counter-current has been applied.

This completes the description of the main features in the design of the continuous roaster of patent No. 1,113,961. The furnace covered by the claims of patent No. 1,113,962 has but two variations from the first design, i. e., an improvement in method of sealing the cover of the roasting chamber, a sealing trough being provided for the cleated rim of the cover; and the use of rotating or rocking rolls for grates, these rolls being provided with toothed projections and with contiguous rolls operating in opposite directions.

Advantages of the Holt-Dern Furnace.

The advantages claimed for the continuous type of furnace are:

1. No appreciable volatilization of metals.
2. No dusting.
3. An ideal percolation product, even though there may be slime in the original ore.
4. Low fuel consumption.
5. High metal recoveries gold, silver and copper.
6. Roaster gases available for condensation.
7. Low operating cost.

COSTS OF ROASTING.

From operations at the Park City plant, roasting costs have been given out as follows:

	25 ton, intermittent	35 ton, continuous.
Labor	$ 0.380	$ 0.054
Power	.049	.045
Repairs	.026	.020
Starting oil	.038	——
Coal dust	.046	.046
Total	$ 0.539	$ 0.165

The cost of salt is about the same in both cases, $0.35. All costs are "per ton of ore roasted."

On an installation of 150 tons daily capacity of continuous roasters, an estimate of total operating costs advanced by Mr. Holt is as follows:

Crushing	$ 0.153
Drying	.092
Rolling, Mixing	.250
Roasting and salt	.540
Leaching	.360
Tailing discharge	.061
Cleanup	.041
Assays	.015
General excl. depreciation	.186
	$ 1.698

with a 90 percent metal extraction.

These figures are based on the actual operating results of the Park City plant which has been operating 8 intermittent and one continuous roaster.

Salt costs, $1.50 f. o. b., Salt Lake City, and with freight and handling about $5 per ton in the mill bins.

Coal dust purchased at the mines for 25 cents per ton.

Operation Factors.

The moisture allowed and desired in the ore is that amount just sufficient to moisten all the slime particles in the ore. Upon the subsequent mixing of the crushed ore, fuel and salt much of the success of the roasting operation depends, so the mixing step receives careful attention both in design and operation.

The roasting temperature must be low enough to prevent any fusing or sintering of the calcines. Regulation is attained by means of a proper manipulation of the percentages of fuel and moisture, and the volume of air blast.

Warm leaching solutions are used, the requisite heat being provided in summer months by that secured from the hot calcines as they are sluiced from the furnaces. In winter times it becomes necessary to inject steam into the iron boxes.

The solutions are corrosive, carrying acids, free chlorine and chlorides and sulphates of the metals. Therefore, for pumping purposes a Pohle air-lift system of wooden solution pipes and rubber air connection is used.

Factors of Ore Composition.

Under this head come the various factores of composition which enter into a consideration of the applicability of this process to any particular ore. The reactions of copper and silver chloridizing are public knowledge and apply to the process under description as well as to other types of chloridizing. A general summary, however, of the important factores of ore-composition applying to Holt-Dern chloridizing, seems appropriate.

Park City results, as well as many others obtained in tests carried on in various parts of the United States seem perfectly determinate of successful extractions on gold, silver and copper contents of low-grade ores, provided other factores, as shall be considered below, are not prohibitive to the operations of the process.

Gangues of quartz or porphyry are indifferent to the reactions taking place in chloridizing and therefore ores high in such factors are especially desirable. Gangues of limestone or of magnesium compounds take very active parts in the reactions and to such an extent that ores with such gangues may or may not be accessible to chloridizing methods.

Limestone is very detrimental, both in the roasting and in the leaching. In the roasting, the oxide of lime decomposes the metal salts and also silver chloride. Thus, chloridization of values is rendered imperfect. In the leaching, any undecomposed lime reacts with the acid, thus weakening the solvent action of the leaching solution, for the solvent action of brine is largely dependent upon the presence of a small amount of free acid. However, should sulphur be present or be introduced in quantity sufficient to convert the lime to chloride or sulphate, a good chloridization of silver and copper is obtained. In one instance of testing, an ore containing 23 percent lime, was successfully treated by roasting with an addition of 12 percent pyrite and 10 percent salt. Thus might be indicated an economic limit only, for lime, the maximum allowable percentage being determined by the cost of the necessary pyrite addition. This consideration of lime content suggests another solution of handling unfavourable factors, the mixing of ores preparatory to treatment. Magnesium compounds act similarly to those of lime.

Aresnic and antimony occurring in small amounts usually volatilize off as chlorides.

Silver locked up in zinc or lead sulphides may be productive of difficulty in extraction. An oxidizing roast followed by a chloridizing roast may secure the desired results.

Zinc sulphide and oxide reactions in chloridizing have not been studied very widely, at least the literature to date would so indicate. The Bunker Hill & Sullivan, at Kellogg, Idaho, has for some time been experimenting with zinc and lead chlorinating but very recent information has been received to the effect that the work on zinc has been abandoned to total effort towards lead recoveries.

The Holt-Dern people have paid but slight attention to lead-recovery to date, although they have attained about a 40 percent extraction of their very low lead heads. Probably the leaching extraction has been more, but the iron precipitation has been inefficient. Electrolytic deposition experiments have been very unsuccessful (from brine acid mill solutions) both at Park City and at a certain large smelter in the Salt Lake valley.

Pyrite in the ore is advantageous in providing sulphur for the reactions, for neutralizing lime and magnesium and for combustion, thus lowering the amount of fuel necessary. Sulphur in excess of the amount neccessary for the forgoing purposes lengthens the period of roast but provides escaping fumes that may be condensed to liquors for leaching purposes.

Manganese especially, and also iron in the charge, ave very beneficial tendencies, aiding evidently in he chloridizing in catylitic ways.

Factors in an Ideal Ore.

An ore highly ideal to the Holt-Dern chloridizing rocess would contain: low content, some pyrite, ome manganese and high silica percent. It is understood hat the copper, silver and gold values must be low.

1. The process seems to have a field distinctly its wn, i. e., low grade silver or gold ores having a small opper content but still sufficient to bar the cyanide rocess.

2. Another field seems open to the process and ithout competition i. e., very low grade copper ores ncapable of other efficient or economical methods.

3. On low grade silver and gold ores, certain lo-alities may present local economic conditions (such s coal or salt sources) which may outclass the econ-mic value of cyanide work.

Very little work has been done by the Holt-Dern eople as to the possibility of handling other metals. ead, zinc, nickel, and other separations have been nentioned as being in line of investigation.

The joint experiment station of the University of Utah nd of the U. S. Bureau of Mines in Salt Lake City s at present working on such possibilities of the Holt rocess among other metallurgical problems. It is robable that some of the work on zinc and lead may e released to the public in the near future.

Trade of Latin American and United States.

Reports carefully collected by the Pan American Union from exporters, importers and Custom Houses n both the United States and Latin American show n encouraging improvement in commercial and nancial conditions in many of the countries of Cen-ral and South America.

Responses to letters and telegrams sent out by Director General Barrett to representative officials nd agencies in both North and South America have more optimistic tone than they did formerly. While ome manufacturers report no increase in orders and ome countries are not increasing their purchases, the eneral trend is forward instead of stationary or ackward.

Exports from some of the principal ports of the Jnited States, especially New York, show a notable ncrease in quantity, variety and value of exports over ne and two months ago. For example, exports from he port of New York to Argentina increased in Fe-ruary from $1,142,901 to $2,049,971, and to Brazil rom $1,782,656 to $2,081,601. The demand for teamship and cargo space is correspondingly improv-ng as shown by the fact that one South American ne has just charted, aside from its seven regular ves-els, as an extra boat, the big "Californian," flying he American flag, which will soon leave with a cargo f 12,000 tons of manufactured products, one of the rgest single cargoes ever sent to South America rom the United States. A careful investigation, oreover, of articles exported shows that a large ercentage of them are manufactured products which ere formerly purchased by South American mostly in reat Britain, Germany and France.

A Water Cooling Device.

Written for the Mexican Journal.
By H. J. Volker, E. M. *

A device for cooling the water used in the jackets of air compressor cylinders or gas engines is illustrated in the accompanying illustration. The scheme is used at the No. 3 Mine of the Canadian Copper Co. Its simplicity should recommend itself especially to those in out-of-the-way places since it may be constructed very largely with material usually to be found at any mining camp.

Pipe Discharging Water at Top of Tower.

The water from the air compressor jacket is conducted to the top of the tower illustrated. The top shelf of this tower is simply a coarse screen which roughly disseminates the water and allows it to fall on the four lower shelves which are again coarse screens but covered with twigs and branches. In this descent the water is forced to disintegrate into very fine particles and the large amount of surface thus exposed permits of a large drop in the temperature of the water. From the basin below the tower into which the water flows, the water is pumped into the compressor jackets and thus the circuit is completed.

The pump illustrated is an ordinary single cylinder air driven piston pump. At present, however, a small electrically driven centrifugal is used.

I have not any quantitative values at hand to show such data as temperature drop, cubic size of tower needed for horse power of compressor cooled, etc., and doubt if any such has ever been made. But the tower illustrated successfully cooled water for compressors aggregating about 1000 H. P. when going simultaneously, and the tower can be lengthened very readily to cope with almost any reasonable conditions.

Antimony is used in the following alloys: Britania metal, Sb., 10 per cent; and Sn, 90 per cent. Pewter, Sb, 7.1 per cent.; Bi, 1.8 per cent; and Sn, 89.3 per cent Hard babbitt, Sn, 100 lb.; Sb, 10 lb.; and Cu, 10 lb. Softer babbitt, Pb, 80 lb.; Sb, 15 lb.; and Sn, 5 lb. Linotype metal, Pb 83 lb.; Sb, 12 lb.; and Sn, 5 lb. Electrotype metal, Pb, 100 lb.; Sb, 10 lb.; and Sn, 5 pounds.

The rivers of the United States carry to tidewater every year 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter. This total of 783,000,000 tons represents more than 350,000,000 cubic yards of rock, or 610,000,000 cubic yards of surface soil.

* Montreal, Canada.

Pachuca.

Early Mining History of Pachuca.

By Morrill B. Spaulding.

The mines of Pachuca, were discovered, according to the historian Garcia, in 1551, and the "Xacal" and "Encino" mines soon after opened on the famous Rosario vein.

In 1557 Bartolomé de Medina discovered the patio process of amalgamation for silver ores at Pachuca, and this added largely to Pachuca's fame enabling it to immediately produce silver from the rich surface deposits.

However, little is definitely known of the mines of Pachuca and Real del Monte until 1749, except that they had yielded considerable quantities of silver from irregular and detached surface workings, and had at last been almost entirely abandoned on account of the influx of water, as the excavations increased in depth. In 1749 Don Pedro Terreros, a merchant of Queretaro, joined a practical miner named Bustamante in a general denuncio of the district, by which they obtained possession of its then two principal veins, the Vizcaina and Santa Brigida ,on the condition of effecting their drainage by means of an adit. For this purpose a location was chosen sufficiently down the slope of the northern descent of the Real del Monte valley, to ensure its entering the principal mines on the Vizcaina vein at the depth of 600 ft. from the surface, but as the distance necessary to obtain this difference of level was nearly 9000 ft. the work, although commenced in 1749 was not completed until 1759. Bustamante did not live to see the result of this great work, but Terreros persevered to reap the reward, for, having by this adit freed the mine from water, he extracted, at a comparatively small cost, up to his death in 1781, the amount of $15,000,000. He was also ennobled by the King of Spain under the title of Conde de Regla.

His successor, the second Conde, continued the working of the mines, but not to an equal profit with his father, who, having exhausted the upper portions of the veins, rendered dry by the adit, left his son the more difficult task of contending with the water under that level. This drainage was effected by malacates, which raising the water in raw-hide bags to the level of the adit, were for some time sufficiently effective, but gradually as the mines became deeper, the difficulty and cost of drainage with such imperfect machinery also augmented.

In the year 1801 the 28 malacates then at work, occupying 1200 horses, with 400 men, and costing $250.000 per annum, were not found sufficient to keep down the water to 324 ft. below the adit, to which depth the workings on the Vizcaina vein had attained in the mines of Santa Teresa and Guadalupe. Consequently, although these mines were then producing at the rate of $400,000 annually, the drainage was suspended, and their deeper workings abandoned. After this time the workings were limited to a higher level, and on the hitherto unexplored extensions of the vein, and up to 1809, when the second Conde died, the mines of San Ramon, with some others, continued to yield about $300,000 per annum. From this period the production of the mines gradually decreased, and the War of Independence having commenced their working was entirely suspended in 1819; the total production since the death of the first Conde having been $10,000,000.

After the recognition of the Independence of Mexico by Great Britain, the attention of English capitalists became directed to the mines of that country, and, at the suggestion of the late John Taylor, an association known as the Real del Monte Co. was formed for rehabilitating and draining the mines belonging to the Regla family.

In July, 1824, Captain Vetch of the Royal Engineers, the first Commissioner of the Real del Monte Co., arrived at the mines, which he found in a estate of utter ruin; most of the shafts had caved, leaving their former sites only to be detected by immense hollows overgrown with brushwood. A still more serious matter was the destruction of the drainage adit, which having in many parts so gone to ruin that it no longer carried off the water, and consequently it rose to a great height in the mines.

All the machinery in the large reduction works was either destroyed or removed, the population had become very scarce, and the town a collection of ruins. The chief inducement for the new company to resume the drainage of these deep levels, was the economies they expected to derive substituting steam power for the imperfect and costly one by malacates, both for raising water and ore, in raw-hide bags. Miners and mechanics arrived at Vera Cruz in May, 1825, under the charge of Colonel Colquhoun of the Royal Artillery. The rainy season commenced shortly after, attended by its usual scourge, the yellow fever, and soon made sad havoc among both English and Mexicans. Colquhoun, however, persevered through all difficulties, and by May, 1826, the engines had arrived at the mines. In the meantime, the district of Real del Monte had been carefully surveyed, the great adit cleared and repaired, many shafts had been also repaired down to the adit level, and buildings, workshops, and stores were rapidly rising around the mines. From this period the work of clearing and restoration progressed steadily, until by the end of 1829, the drainage had been effected to the depth of 324 ft. below the adit.

The actual cost of pumping did not exceed $30,000 per annum, being an immense saving as compared with the large sum of $250,000 which the 28 malacates formerly employed for this purpose had cost the second Conde, when at the same depth he had abandoned the lower workings.

It, however, soon became evident that the drainage at the distant points of San Cayetano and Dolores was not sufficiently effective for working the richest portions of the vein in the mine of Santa Teresa, and a new vertical shaft was consequently sunk and a more powerful engine erected. An engine with a 54-in. cylinder (Cornish pump engine) having been erected, and assisted by the smaller ones at Dolores and San Cayetano, this portion of the Vizcaina vein was worked for some time with considerable profit, and to the

Mine Buildings, Pachuca

Guerrero Mill of Real del Monte Co.

depth of 1410 ft. from the surface, and 720 ft. below the level of the adit. At this level the water having so increased as to again exceed its capacity, a still larger engine of 75-in. was erected at Dolores. (This engine was in continual use up to 1908.) The reward of this expenditure was two large bodies of rich ore, the one on the Santa Brigida vein, near the Acosta mine, and called La Luz, and the other at San Enrique on the Vizcaina vein, near Dolores.

Cornish Pumps.

Up to the end of 1847, however, the general result of working the mines had been decidedly unfortunate to the English investors, for although they had profited by three rich bodies of ore at Terreros, Acosta and Dolores, which had produced $10,481,475 worth of silver, the outlay on all the undertakings of the company had also reached the amount of $15,381,683—leaving a loss of nearly $5,000,000 as the result of the 23 years they had held the mines.

The deep workings were now 720 ft. below the great drainage adit, or 360 ft. below the point at which they had been abandoned by the second Conde, and the difficulty of drainage had so increased, both by the augmented quantity of water, and the greater height to which it was necessary to raise it, that three powerful steam pumps (Cornish), which were discharging 2700 gal. per minute, at a cost of $90,000 per annum, could barely hold the water coming into the mines.

The difference of the cost of steam-drainage as compared with malacates, becomes at this point interesting. The English company, at the commencement, had easily effected with two small engines, and at a cost of $30,000 what the Conde de Regla had been obliged to relinquish in 1801, 28 malacates, and at an annual cost of $250,000; but with the increased depth and greater volume of water, three pumping-engines and expending $90,000 were barely able to maintain the drainage, while to replace them would have required at least 180 malacates, employing 7000 horses with upwards of 2000 men, and an expenditure of not less than $2,000,000 per annum.

With this increased difficulty of drainage, the rich bodies of ore all worked out, and a debt of $5,000,000, it is not surprising that the energy and perseverence of the English investors were at last exhausted.

Towards the middle of the year 1848, Don Manuel Escandon and Don Nicanor Béistegui were included by Mr. Buchan, the manager of the mines under the original Real del Monte Co., to take up the enterprise on terms which, although not returning to the English investors much on their capital, at least relieved them of all further responsibilily. The new company was formed as a leasing company, and organized under the old laws of Mexico, which allowed the avio form of contracts in which they were allowed 3 percent upon all the expenditures made upon the individual mines to cover the cost of administration and general expense. At the same time all and every expense incurred in the development, operation and equipment of the property, was charged against it.

More Extensive Operation.

After having carefully examined the condition of the enterprise, Mr. Buchan came to the conclusion, and so reported to the company, that the properties had hitherto been worked on too limited a scale, and with too expensive a management, and particularly without any effective attempt to render the lower grade and more abundant ores available for treatment, or to make new discoveries in the higher and still virgin portions of the veins, every effort having been directed to the search after rich ores in depth, which, when discovered, did not repay the large amount of money expended.

To reduce the excesive cost of drainage the very workings on the Vizcaina vein were abandoned, and the water was maintained at 390 ft. below the drainage adit by one large steam pump, while at the same time the extraction of the lower grade ores was facilitated and increased by additional shafts, hoisting machinery, and the installation of underground track and cars. Conjointly with these operations, the eastern and yet virgin portion of the Vizcaina vein, was selected as the object of further exploration, and in the area above the drainage level. Exploration was also commenced at Pachuca in the Rosario mine, where the company had already worked and incurred considerable loss by extracting ores from the old mine, but finding that the famous vein of Xacal would intersect that of Rosario to the eastward of all former workings, it was decided to take advantage of an adit already considerably advanced, to examine so promising an area. After driving this adit some 360 ft. the expected intersection of the veins was encountered, and a large body of ore uncovered, from which a considerable extraction of ore was immediately commenced.

It is a peculiarity of the mineral veins of this district that while those which run in an easterly and westerly direction produce ores readily amenable to the usual

patio process of amalgamation, practiced to so great an extent in Mexico, the ores from the north and south veins have a different mineral character, and in many cases will not yield their silver by this process. Trials having, however, proved that these ores could be economically treated by a modification of the well-known barrel and chloridizing-roast system of Freiberg, and the great mass of the lower grade ores being of this character, it was determined to adopt this barrel amalgamation process on a large scale for the quemazon, or refractory ore.

Patio Process.

For this purpose two new works were erected, at San Miguel and Velasco, while those of Regla and Sanchez were enlarged and modified. In the Haciendas of San Miguel and Regla, which are at a distance of 12 miles from the mines, water power was alone used to operate the machinery, blow the furnaces, grind the ores and revolve the barrels, but in those at Sanchez and Velasco, erected at the mouth of the valley descending from the mines, steam was employed. In 1855, besides the large Cornish pump with 75-in. cylinder, which drained the mines, there were, at the reduction works two smaller rotary engines and 18 water wheels of different sizes, which drove 116 wet stamps, 16 large and three Chilean mills, all grinding ore; besides revolving 64 large barrels in which the prepared ores were amalgamated. In the Hacienda of Regla were 8 blast furnaces for smelting rich ores, and in San Miguel, Velasco and Sanchez 36 reverberatory furnaces for drying and roasting the ores, preparatory to amalgamation in barrels. After 1855 the Hacienda of Loreto was erected, which, situated in the midst of the Pachuca mines, was gradually increased so that it treated 100,000 cargas of 300 lb. each of ore per annum. (15,000 short tons.)

The following is a brief list of the Cornish steam pumps in operation in 1860:

Real del Monte district Dolores shaft, 75-in cylinder; Acosta shaft, 54-in. cylinder; San Patricio shaft, 30-in. cylinder.

Pachuca district—San Juan shaft, 85-in. cylinder (in use in 1908); San Nicolas shaft, 30-in. cylinder; Corteza shaft, 30-in. cylinder; Rosario shaft, 18-in. cylinder.

There were in use eight rotary engines for hoisting, reduction works and shops. The reduction works comprised the Loreto, Guerrero, Aviadero, Sanchez, Velasco, Peñafiel, San Miguel, and Regla, all of which used 29 water wheels.

Street in Pachuca.

British Cemetery at Real del Monte

The reduction machinery amounted to 350 stamp-heads, 24 water-power and 50 mule-power arrastras, and 80 amalgamation barrels.

In Mr. Buchan's report of 1866, for the preceding years, he remarks:

"That no dividends were paid to share-holders of the company in 1865, must not be attributed to any failure of the mines themselves, but that during the very unsettled political state of Mexico, our expenses were very greatly augmented by the increased price of materials, and the loss incurred in keeping up a considerable military force for the security of the district. Contributions and forced loans to different goverments have for several years past been exceedingly heavy, but with the hope of their speedy repayment, these sums have been carried to a "Suspense Account," until the amount became so large as to determine the company to suspend dividends, and dedicate all their share of profits to the liquidation of this debt.

"The great formation of ore in the Rosario vein of Pachuca, which since its discovery in 1850 has yielded $25,000,000, still promises a steady continuance of production; and although by its dipping south and pitching south-eastward, this pay-ground is now passing gradually out of the old mine Rosario into the neighboring claims of San Pedro and Guatimotzin to the benefit of the owners of these latter, yet this will not affect the company, whose interest is equal in all.

"The mine of Xacal, on the same vein, and adjoining the Rosario to the west, which in former times was so famous for its richness, and the chief inducement for the drainage of the Pachuca district, has hitherto proved a great disappointment, by being found poor in its lower workings."

Huebnerite is tungstate of manganese with 76.6 per cent tungstic trioxide, while wolframite is tungstate of manganese and iron with 76.4 per cent tungstic trioxide. They are heavy, dark gray to black minerals occuring in crystals, columnar masses and granular, with sub-metallic luster. If finally pulverized and treated with hot, strong, hydrochric acid, they partly dissolve. The solution turns blue upon adding tin or zinc and heating.

No two mines in the world have produced either gold and silver at the same cost for any extended period. Local conditions, character of ore, methods of treatment, and the personal intellectual equation of the mine manager, are factors that make it almost impossible to operate two proporties at the same cost and produce the same results.

Burma is the largest tungsten producer in the world, the United States coming second with about half the Burmese production, and being closely followed by Portugal. The tungsten production of the United States in 1913 was 1,537 tons of tungsten concentrates containning 60 per cent tungstic acid.

Geology of the Pis Pis Mining District in Nicaragua.

By Oscar H. Hershey. *

The Pis Pis mining district in Nicaragua comprises an area about 11 miles long in a northeast direction, and about 1¼ miles wide. It is situated in the valley of the Pis Pis river (a tributary of the Waspuc river,) on the divide which separates that stream from the Tunky and Banbana rivers (tributaries of the Prinzapulca river,) and in the basin of the Tunky river. Its exact situation is not known, but it has an estimated distance from Cape Gracias a Dios of about 225 miles by the Wanks, Waspuc, and Pis Pis rivers, and from Prinzapulca of about 195 miles by Prinzapulca, Banbana and Tunky rivers.

In the spring of 1910 I accompanied a party of mining engineers to the Pis Pis district and spent about 15 days in it. The general character of the rocks was evident in the field, but to get an expert petographer's opinion on the names that should be applied to them, a set of thin sections was submitted to A. C. Lawson, of the University of California. They were studied by a student at the university, but his report was reviewed and amended by Mr. Lawson. The detailed descriptive notes have been incorporated in a paper entitled Geological Reconnaissance in Northeastern Nicaragua which was read by title at the March 1911 meeting of the Cordilleran Section of the Geological Society of America and will be printed in the bulletin of that Society. It is not my purpose to go at length into the general geology, but to treat the subject rather from an economic standpoint.

The greater portion of the district is occupied by a thick series of andesite lavas and fragmental rocks, to much of which the term augite-andesite may be applied. Scattered through this are dikes and irregular masses of a hard andesite, to which also the term augite-andesite is applicable.

Character of Rocks.

The northeastern portion of the district is characterized by a mass of intrusive ryolite about 4 miles long and 1 mile in maximum width. Rhyolite also occurs in a narrow band of hard, flinty-appearing rock that has given rise to the big falls on the Pis Pis river. A portion of the foot-wall of the Bonanza vein has an appearance suggesting a partly decomposed diorite, but no material fresh enough for microscopic study could be secured.

The Pis Pis district is traversed by a remarkable system of large gold-quartz veins. All the larger veins have a northeast-southwest course and dip northwest at angles varying from 45 to 75 deg. Some of the smaller veins are transverse to the larger ones. All have resemblances which indicate that they are members of one system, but each has some character distinguishing it from the other. They were deposited in actual open fissures which were probably reopened from to time, producing a fairly definite ribbon structure.

The gangue is generally a fine-grained quartz, in part hard and barren, and in part impregnated by sulphides. Crustification is common, and there are many crystallized vugs. Generally there is no evidence of metasomatic replacement, but in places there are fragments of country rock in the vein which may in part have been replaced by quartz and sulphides. In the Bonanza and neighboring veins much of the unoxidized ore has a green stain, evidently due to chlorite.

The sulphides almost invariably present below the zone of oxidation are pyrite, galena, sphalerite, and chalcopyrite, in greatly varying proportions.

The Mines.

The mines are in two groups, the northeastern and south western, with a space of about $3^1/_3$ miles between, in which the veins are present, but not denounced and developed. The northeastern mines (except the Lone Star and Panama (including the Bonanza,) Mars and Neptune are grouped about the rhyolite area. They are relatively rich in quartz and low in sulphide content. The Lone Star is in intrusive augite-andesite at some distance from the rhyolite area, and it shows an increase of sulphide particularly galena.

The southwestern group, including the Siempre Viva, Constancia, Concordia, and Trinidad mines, is in andesite, and relatively rich in sulphides. The veins of this group are characterized by the presence of a large quantity of fine-grained hematite (specularite.) Thus I have gained the impression that the veins cutting the basic roks are richer in sulphides and other basic minerals than those in and near the rhyolite area, making it more difficult to extract the gold from the sulphide ore. The Bonanza and Mars veins are quite favorable in this respect.

The rock bordering the large veins abounds in seams of quartz extending 30 to 100 ft. from the vein proper. They consist of the same kind of quartz and sulphides as the larger veins, and doubtless carry gold, but it does not appear that they have made any important ore bodies.

These stringers are best developed in the extrusive andesite, least in the rhylite.

Influence of Country Rock.

Aside from these facts, I cannot see that the country rock has any important influence over the veins. They are developed in all the formations of the district and pass readily from one to another. I could not secure any good evidence that the deposit of gold has been controlled by the wall-rock. The large veins are in the form of a succession of lenses which may be 50 to 500 ft. long and 10 to 85 ft. in maximum width, connected by short stringers of quartz 6 in. to 3 ft. thick. It is a rule throughout the district that the wider portions of the veins are richer in gold than the narrower portions; but the smaller veins, called "threads," 2 to 5 ft. thick, and which are often spurs from the large veins, are generally of higher grade ore than the large veins. Mine owners in the district try to connect the Siempre Viva, Lone Star, and Mars veins as one vein about 10 miles long, but I think the large veins are only 1 to 3 miles long, dying out into a group of stringers.

Although the veins are in strong fissures, there is not much evidence that they are due to faulting. Strong gouges are not often present along the walls, and the gouges present are likely to be within the veins as on the wall, and are perhaps due to comparatively recent

* Mining Geologist of Alaska-Treadwell Mining Co.

movements. This distribution of the wall-rock along the veins in a few places indicates some displacement, but I believe that in general, faulting has not been an important feature. As to transverse post-mineral faulting, there has been little of it; only one important fault of this nature was detected.

Enrichment.

I can see no reason why, at any depth at which these veins are cutting the same formations as appear at the surface, they should not be as strongly developed and carry the same content in gold silver as they do in the upper part of the sulphide zone, except possibly such decrease in value with depth as may be common to gold quartz veins in general. I can see no evidence of secondary enrichment below the zone of oxidation. When the veins pass beneath the volcanic series they may traverse sedimentary formations, and some change may be expected. For reasons too elaborate for this paper, I anticipate that this will not occur short of at least 1500 ft. in depth.

Besides, veins which, like the Bonanza, probably pass into the rhyolite mass, may traverse it to such depth that the base of the andesite may not figure seriously in the future of the mines. The vein system is strongly developed in the extrusive andesite on both sides of the Pis Pis district, but from the fact that mines have not been opened on it beyond the district (except in far-distant localities.) I presume that it carries much less gold. This suggests to me that the gold is not so much due to the extrusive andesite as to the intrusive rock present in the district; and carried further I arrive at the pyrite-impregnated rhyolite as the probable source of the gold. It may be present at depth under the Siempre Viva mine.

Near the surface the sulphides are generally thoroughly oxidized to limonite, with irregularly distributed pyromorphyte, cerussite, and malachite in small amounts. The gold associated with the sulphides chiefly (hard white quartz is practically barren) is then freed and may be seen in the pan as very fine grains.

The Ores.

As a general rule the most porous ruck is the richest. In the southwestern group the hematite remains unchanged to near the surface. Very near the surface the thoroughly decomposed wall-rocks fail to support the vein, and it falls to pieces of quartz imbedded in red clay, forming the so called manta. This works down neighboring slopes and may form an irregular sheet from 2 to 10 ft. thick. The Bonanza mine has the strongest development of manta because the vein outcrops on the crest of a low, broad ridge. Where the slope is very steep, as at the Lone Star mine, there is no workable manta. Most of the mines have worked some manta, but much more of the vein in place.

The mines pass rather rapidly from the oxidized to the unoxidized zone, there being no strongly marked zone of mixed sulphides and secondary oxidized minerals. To this I must make the exception that certain compact portions of the veins may remain unoxidized to the surface. At the Bonanza mine sulphide ore appears at a number of places in hard compact portions of the vein within 30 ft. of the surface as it was before mining began. Some oxidations may extend down along seams to a depth of 100 ft., but I believe the bulk of the vein is unoxidized at 50 ft. from the nearest point on the surface, or say 100 ft. from the outcrop.

In the Neptune vein sulphide ore occurs in places practically at the surface, and the oxidized zone is probably nowhere deep enough to be seriously considered. The Mars mine is not developed to the sulphide zone proper, but bunches of unoxidized ore occur within hundreds of feet of adits in the sulphide zone. In disregard of its outcrop high above neighboring creeks, 50 to 75 ft. of the surface. The Lone Star mine has and the relatively high sulphide content favoring oxidation, the zone of oxidation probably nowhere extends more than 100 ft. from the nearest point on the surface and the weathering of the country rock to a not much greater depth.

At the big vein at Constancia mine, outcropping on the crest of a high ridge, sulphides are appearing in bunches at 160 ft. and on the La Leticia vein only sulphide ore comes from the bottom of a shaft 100 ft. deep. The zone of oxidation in the Siempre Viva vein along the 2300 ft. length developed in the Siempre Viva mine, extends down 50 to 200 ft., generally 100 to 150 ft. The Concordia mine, on the same vein, had not reached sulphides at 60 ft. At the Trinidad mine, also on the Siempre Viva vein, the zone of oxidation extends from 75 to 150 ft. deep.

These observations prove beyond doubt that nowhere in the district does the zone of oxidation extend very deep, rarely to 200 ft., probably 100 ft. would be near an average. The humidity of the climate and the protection afforded by the stiff clay covering are the reasons for this shallow depth of oxidation. Hence, any propositions must take the sulphide ore into immediate consideration, and milling plants should be planned on this basis.

The question of the tenor of the sulphide ore is interesting the miners. Its importance lies in the fact that the grade of the oxidised ore at most of the mines is so low that, in view of the probably lower extraction and increased cost of working any considerable decrease in the average content of the ore in passing from the oxidized to the unoxidized zone would be fatal to the future profitable operation of the mines. In fact, at several of the important mines the end of the oxidized ore is in sight, and managers realize that they are approaching the time when they must face the problem of working the sulphide ore; hence, they have given some thought to the subject and have some impressions. As I have reasons to believe that one of these managers will shortly treat this subject at length in public communication, I will confine myself to the remark that after due consideration of the expressed opinions, statements of assays in various places, and the result of sampling at the most important mine, I have concluded that the sulphide ore will average as much lower than the oxidized ore as would be exacted from the lessening in weight of the former by leaching of the sulphides and other basic minerals except the hematite.

The exact percentage of decrease will have to be determined for each vein by elaborate development and sampling.

Calabacillas Gold Mine, Chihuahua.

Charles Walter Geddes.

The Calabacillas mine, in the State of Chihuahua, Mexico, close to the junction of the States of Chihuahua, Sinaloa, and Durango, is perhaps one of the most interesting mines of the entire West Coast, not alone for the reason of its being one af the few new gold mines of Mexico, but also because of its development, since its discovery by a native Indian, by local Mexican owners. It now represents one of the few 'one man' gold mines of the world. The purity of the gold contained in the ores, and the almost perfect saving by direct amalgamation, allows the use of the oft abused term 'free-milling ore.'

The original discovery was made accidentally by an Indian, bearing the same name as the famous Apache chief, Geronimo, in the year 1899. He sold his entire interest for a old musket and two cows. The property then passed into the hands of a Mexican syndicate and was worked for several years on a unique co-operative plan. Starting on the surface where rich ore was discovered, shallow shafts, pits, and trenches were made and the ore so extracted divided among the different owners in proportion to their holdings in the syndicate. After this division, by weight or measurement in boxes, with no regard to the values contained, the respective owners would convey the ore to their homes, or haciendas, and treat it in arrastres.

Later two Bryan mills were installed, and the operations better organized. During this period the property produced $350,000 gold at small expense. The usual vicissitudes attending the transition of a prospect into a mine occurred during the next two years until the entire property and plant was purchased outright and individually by W. H. Brevoort, of New York and Paris.

The mine is in the same range of mountains, paralleling the west coast of Mexico, in which are the famous old mines of Guadalupe y Calvo, Morelos, Batopilas, San José de Gracia, and the more recent Lluvia de Oro the latter being one of the sensational discoveries of the latter decade.

Geology of the District.

The range is composed mainly of andesite, broken here and there by intrusions and extrusions of later porphyries. At Calabacillas is an intrusion of rhyolite, in andesite, having an average width of about 500 ft. on the surface and traceable several miles, until it is lost under more recent flows, tuffs, and breccias. The intrusion forms a sharp anticline on its contact with the andesite, one leg of the anticline having a dip to the east and the other to the west.

Development has so far been confined to the east contact, exposing a zone of brecciated and fissured material extending into the rhyolite a distance of 150 ft. The mass consists of ore shoots characterized by a regular system of fissuring both parallel and transverse to the main contact. There have been developed four, and possibly five, separate, distinct-ore-shoots, varying from 65 ft. by 15, to 100 by 70 ft. and the conditions warrant the expectation of other oreshoots along the strike.

The brecciated rhyolite has become silicified by percolating solutions, and the gold has been deposited in the fissures and seams of the brecciated mass, in connection with different iron minerals. The term 'free-milling ore' has been so misused that it has lost practical significance, but at Calabacillas is an absolutely typical free-milling ore. Fine-grinding tests indicate that with sufficient plate-area from 95 to 97 percent of the total gold-content can be saved by amalgamation. The silver content is practically nil, the retorted bullion showing only 35 oz. silver to 500 oz. of gold.

Due to the character of the ore the milling practice is simple. The original mill consisted of two Bryan mills with plate-area of 4 by 12 ft. Later 10 stamps of 850-lb. weight were added. Inside amalgamation was used, with an outside plate-area of 4 by 10 ft. to each battery. A small cyanide plant was installed, having a daily capacity of 15 tons. Another battery of 10 stamps, of 800-lb. weight each, was later installed, and the Bryan mill discarded. A very simple cyanide leaching plant, handles 40 to 50 tons per day.

Ore Treatment.

The ore as broken in the mine is delivered to the mill by a surface tramway, passed over grizzlies, and the coarse through a 10 by 11-in. Dodge crusher, crushing to one inch; then to the batteries. The stamps have an 8-in. drop, 100 drops to the minute, and crush the ore through No. 30-mesh screens, using inside as well as outside amalgamation. The pulp is carried direct from the plates, by launder, to the tailing dump, where 15 tons daily are used in the present cyanide plant, the remainder being impounded for future treatment.

The average daily run shows a saving of 80 per cent by straight amalgamation, when crushing through 30-mesh, while the cyanide plant, after 5 days leaching, recovers 80 per cent of the value contained in the tailing, making the total saving 96 per cent.

Considering that this ore, coming as it does from a depth of 400 ft., is crushed through 30-mesh only, it would seem that the above recovery by amalgamation is remarkable.

Self-Hardening Steel.

In high-speed steel practice, the disposition on the part of users as well as makers, has been to use one steel for all purposes, tools for cutting hard as well as soft materials (wood among the rest), forming dies, crushers or hammers, rock-drills, and all the rest of the category of tools. Most manufacturers make extravagant claims for universal high efficiency on behalf of their particular steels. It is true that some steels on the market come pretty near fulfilling the various conditions requisite to universal service, not only making good cutting-tools for hard and soft metal and wood, but being suitable also for forming dies, crushing-tools, hammer-tools, and the like.

For the most part, however, the high-speed steels now on the market are adapted to particular rather than to general service. Thus a steel highly efficient in cutting hard material often is not so on soft; and one well suited to cutting is not very likely to be well suited to forming dies. One steel said to be superior to any other in all kinds of metal cutting has the composition:

	Per cent.	Per cent.
Vanadium	0.32	0.29
Tungsten	17.81	18.19
Chromium	5.95	5.47
Manganese	0.07	0.11
Carbon	0.682	0.674
Silicon	0.049	0.043
Sulphur	.....	.....
Phosphorus	.....	.....
Iron (presumably)	75.119	75.223

Though nothing is said as to its efficiency in tools other than those for metal cutting, the composition of this steel indicates that it is also good for all tools requiring toughness and wearing quality; so that it may fairly be classed as an all-round steel.

Other things equal, it would be highly desirable to have in a shop one all-round steel equally and in a high degree efficient in all sorts of work. The need for so many varieties of tool-steel heretofore has been a source of great inconvenience, of frequent mistakes, and untold annoyance, all which would be dissipated could a single steel be economically substituted for the many varieties now in use.

Steels have recently been put upon the market, at prices greatly below those asked for the ordinary grades of high-speed steel, which are especially adapted

Waiting to be Paid off

Courtesy Mexico View Co.

Market Scene.

Courtesy Mexico View Co.

Indian Coffee Workers

Courtesy Mexico View Co

On the Way to the Crockery Market.

Loading the Mexican Ship of the Desert.

Courtesy Mexico View Co

A load of Charcoal.

to some particular class of work, as wood-cutting, for example. These steels are stated to be intermediate between the high-speed and ordinary steels, and evidently are developed from the ordinary self-hardening steels by varying the alloy-content so as to secure the highest degree of toughness and edge-holding quality, essential to tools not expected to stand up to the kind of work required of high-speed tools, rather than red-hardness, which is not essential to this class of tool. They purport to fill a gap which has been recognized ever since high-speed tools first came into general use, furnishing a tool possibly slightly less lasting in service, but at a considerably lower cost.

The precise field for these steels remains to be determined. Doubtless they will come largely into use for wood-working and such metal-working tools as require keen edges, but work in such a way (perhaps at slow speed) that they do not get hot enough at the cutting edge to need a high degree of red-hardness. Some of then are stated to be especially adapted to use in forming and blanking dies, drop dies, and like tools, which require great wear-resistance, but which also generate no great amount of heat while at work.

The minute structure of high-speed steel, as seen in a fracture, does not differ greatly from that of carbon steel. It is, in general, seen to be of a fine and uniformly granular appearance, with the granules smaller and more uniform, generally, that those of carbon steel. In annealed and forged high-speed steel the smoothness of structure is increased; and when hardened, the crystalline structure stands out clearly though the individual crystals are very minute. Under the microscope the structure is seen to be essentially that of carbon steel with certain modifications or additions.

Pearlite is found, though generally in smaller proportion than in carbon steel, and martensite (or hardenite) forms a considerable proportion in many cases. This is true, as might be expected, especially of those steels which are high or moderately high in carbon, and which therefore are quite hard. Austenite is nearly always present in high-speed steel which has been heated beyond the higher critical point, and of course indicates that the steel is tough in proportion to the amount present. Changes in appearance and in structure due to hardening, tempering, and forging, are as noticeable in high-speed steels as in carbon steels.

Geology of Ocampo District, Chihuahua.

The old mining camp of Ocampo, or Jesus Maria, as it was called until a few years ago, is in the extreme western part of the state of Chihuahua. It is 85 miles by mountain trail from Miñaca, the nearest railroad station, on the Chihuahua & Pacific R. R. A wagon road connects it with Temosachic on the Mexico Northwestern R. R., 107 miles distant.

Situated in the heart of the Sierra Madre mountains, the region is one of surpassing scenic beauty. Broad mesas covered with splendid growths of pine lie to the east. The country immediately adjacent is an interminable series of deep, narrow cañons, unusually wooded and always rocky, through which flow crystal-clear mountain streams. The steepness of the country affords little chance for cultivation, but where any of the valleys widen sufficiently to permit it, the ground is cleared for ranching and good crops are raised—corn in the higher and oranges in the lower altitudes.

Ocampo is on the western slope of the continental divide and in the Mayo River drainage. Within short distances, however, are streams flowing into both the Fuerte and the Yaqui Rivers. The Cumbre de Jesús María, 8500 ft. elevation, lies immediately above the town to the northeast; Santa Brigida peak, over 9000 ft. elevation, lies to the northwest. Both these are prominent landmarks. To the south and west the country rapidly drops down to a much lower altitude, and a few hours' ride suffices to bring one into the region of semi-tropical vegetation. The altitude of the town of Ocampo is 5900 ft. above sea-level.

The principal mines occupy an area about five miles long by one or two miles wide. The camp is a comparatively modern one, the discovery having been less than 100 years ago. The largest producers have been the Santa Juliana, Refugio, Santa Eduviges, San José, Matulera and Belén. Records of the total production are not available, but it has been estimated by men who were familiar with the days of most active operation at not less than $100,000,000. The principal oreshoots have been stoped to depths varying from 700 to 1100 ft. below the outcrop. Until recently mining operations have been confined to the orebodies that outcrop on the surface, although it is probable that the formation contains others that show no outcrop. In connection with the reopening of the Ocampo mines by the Sierra Consolidated Mines Co., a comprehensive study of the geology of the district was made by F. H. Kay, of the U. S. Geological Survey, whose excellent work in this connection merits special acknowledgment.

The rocks of the district consist of massive andesite flows, with interbedded rhyolite and andesite tuffs, and with also occasional flows of rhyolite. The period of volcanic activity, of long duration, was post-Mesozoic, and resulted in building up a series of extrusives of great thickness. Following it came a period of gentle folding accompanied by minor faulting. Ocampo lies on the northeast limb of one of the broad anticlines resulting from this folding.

Somewhat later a period of intrusion followed, which, however, was not extensive, and is confined to the western portion of the district. Here are found several dikes and intrusive masses of a basic andesite-porphyry and two small dacite dikes. None of the intrusions have any economic importance.

Orebodies in Fault Zones.

After these intrusions occurred the major faulting of the region. The general trend of the principal faul zones is in a northwest-southeast direction, or more or less parallel to the axis of the anticline. It is in these fault zones that the principal orebodies occur. Intersecting them are other faults striking usually northeast-southwest, but these appear to be earlier as they are found to be offset at points where the intersection can be clearly traced. The determination of the throw of the faults is impossible in nearly all cases, owing to the local nature of the flows and the difficulty in correlation. In two cases, where the throw can be observed with reasonable distinctness, it is found to be 300 to 500 ft. vertically. The northwest-southeast fault zones are quite wide and their formation was accompanied by extensive shearing and alteration. The altered zones are invariably impregnated with ferric oxide, giving to the whole a characteristic red appearance. This results in part from the alteration of the original iron in the andesite, but since in many cases it occurs in the altered rock through all the minute fractures, the bulk of it is probably of secondary origin. Alteration is by no means confined to the fault zones, although it is much more strongly pronounced along them where the rock

is sometimes completely serecitized and its texture entirely lost. Generally the degree of alteration is inversely proportional to the distance from the most pronounced plane of movement in the fault zone, becoming gradually less marked until it can only be detected by the microscope.

Andesite Most Abundantly Distributed.

The andesite is by far the most abundant and characteristic rock of the región, covering fully nine-tenths of the mineralized area. The typical rock has a green or purple groundmass with numerous white plagioclase crystals, which render it distinctly porphyritic in appearance. The more massive variety has a finegrained grayish-green groundmass with fewer and smaller phenocrysts. In many places the andesite has the appearance of a volcanic agglomerate or breccia, in which inclusions of red or reddish-purple rock are inclosed in a greenish groundmass, or vice versa. The phases of this variety of andesite are numerous and varied, the inclusions ranging in size from microscopic particles up to three feet or more in diameter, and the dividing line between the inclusion and groundmass ranging from sharply-marked to a gradual shading out from the one to the other. Part of these ocurrences are true volcanic agglomerates, in which the extrusive magma flowing over the surface absorbed fragments of rock resulting from the breaking down of previous flows of exactly the same character and composition.

Two distinct andesite flows are exposed, separated from each other by tuffs and rhyolite flows, which together have a thickness of nearly 600 ft. Overlying the upper andesite is the principal series of tuffs—both andesitic and rhyolitic—which form the bold outcrops capping the highest hills and constitute a prominent topographical feature of the district. The tuffs are usually massive, but occasionally exhibit a high degree of stratification, the dip being uniformly to the northeast.

The rhyolite variety, easily distinguished by its light color, predominates, but in many places, especially near the bottom of the series, a purple andesitic phase, usually mixed with fragments of the underlying flow, is rather prominent. The tuffs were laid down before the period of faulting, as the faults and shear zones can be traced upwards through them wherever they have not been eroded off.

Ore Occurs as Shoots or Lenses.

The ore deposits occur as shoots or lenses lying along some well pronounced plane of faulting in the wider shear zones, or in the smaller fault fissures. It is only in the latter that the deposits approximate a true vein formation. In the fault zones, which are well defined and traceable for considerable distances, the extensive shearing and subsequent infiltration of mineralizing solutions has produced an andesitic breccia, in which the crushed country rock has been recemented by quartz, and in which, at favorable places, there has been concentration of the gold and silver in sufficient degree to bring about the occurrence of pay shoots. Owing to the irregular distribution of the quartz deposits over the altered area, and the fact that the shear zones usually comprise several distinct fault planes more or less parallel, the ore-bearing formations are more properly termed lodes than veins, the lodes including not only the quartz and ore deposits, but also the more or less silicified altered eruptive which lies along the faults and which is directly related to the ore occurrence. The lodes are sometimes brought into relief by erosion, when the formation is highly silicified and thus rendered harder than the surrounding country rock. Such prominent quartz veins are found along the outcrops of some of the important oreshoots, but not along all of them, and as a matter of fact the lodes are marked throughout the greater part of their length more by the contrasting colors of altered and unaltered material than by topographic relief occasioned by outcropping lodes.

Quartz Occurs in All Formations.

While andesite is the country rock surrounding most of the orebodies, there is no indication of any selective action on the part of the mineralizing solutions that would make the andesite the favorable horizon for ore deposition. The tuffs have been eroded over the greater portion of the area leaving the lodes outcropping in the underlying flows. As quartz outcrops are traceable at several points to the highest tuffs, and as orebodies have been found likewise in the tuffs in other mines in the vicinity, it may be concluded that quartz deposition has occurred in all formations without partiality. The evidence seems to show that the ores came from a deep-seated source and were deposited from ascending waters in the fissures and along the fault planes that afforded them channels of circulation.

The oreshoots are rather irregular in size, shape and grade. The long dimension is always in the plane of the lode, and usually conforming more to the dip than to the strike. There is always one well defined wall along which the ore lies, and occasionally two, although this is less common in the wide shear zones than in the smaller and simpler fault fissures. The most favorable locality is the intersection or junction of a minor fault or fracture with one of the more profound faults. Practically all of the large oreshoots that have been profitable worked lie along such intersection or junction points.

The three principal lodes are the Santa Eduviges, Matulera and Belen. The first mentioned is clearly traceable for over two miles and includes two of the largest mines of the district—the Santa Eduviges and Refugio. The Matulera lode is shorter, extending for a length of three-quarters of a mile and including the mine of the same name. The Belen lode is traceable for about two miles and includes the Belen, San José, Balvanera and San Amado mines. The best instance of an ore deposit in a simple fault fissure with little alteration of the andesite is the Santa Juliana at the extreme eastern end of the camp.

The shoots that have furnished the production of the larger mines have ranged from 300 to 700 ft. in length, from two to 20 ft. in width and extending to a depth as yet undetermined. The Santa Juliana mine was stoped down to a depth of 1100 ft., and recent development work in the Maturela mine has opened the shoot on the 1500-ft. level, with no tendency, it may be added, towards a lower grade of ore.

Ore Composed of Argentite and Gangue.

Mineralogically the ore is practically all argentite. Occasionally small amounts of more complex ores are found, but these occurrences are rare. Associated with the silver there is always some gold; the proportion by weight of silver to gold averaging about 60: 1. Pyrite occurs in abundance throughout all of the lodes, but only rarely is it associated with silver or gold. This pyrite, called by the natives bronce, probably resulted from the alteration of the iron of the andesites. There is also a gold- and silver bearing pyrite—called pasta—of occasional occurrence, associated with the silver sulphides in the oreshoots. This pyrite is probably of secondary origin. It is

usually fairly rich. Near the surface, where the ore is largely oxidized, there is a certain amount of free gold, and in the richer portions of the shoots native silver is not of infrequent occurrence. Naturally in a formation of this character the grade of the ore varies within rather wide limits. The average gross value of the ore at present developed is $12 per ton, while in the enriched portions of the shoots the grade rises to above $500 gross per ton.

*Business Ethics of the Engineer.**

By G. G. S. Lindsey.

Addressing many who have adorned and honored the profession of engineering, I would be unwilling to formulate my opinions on the nature of the moral agent as an intelligent and free being possessed of a conscience, were I not sure that many of my younger hearers are glad to be told what are the points of the compass by which those whose course they are anxious to follow steer; a course always true.

"True as the needle to the pole,
Or as the dial to the sun."

I am not a student of the science of resolving cases of doubtful propriety, but I have had many opportunities of observing the practices of mining engineers, and, though not a qualified technical engineer myself, know fairly well what are the ideals of the best of them.

Professional ethics differ in no respect from some of those promulgated on Mount Sinai. No human rules have as yet been laid down which are binding and which have been accepted as the test to which all mining engineers must subscribe as the standards of their profession. And because there is no law, the greater is the moral obligation on the engineer to fix high standards and voluntary to live up to them on all occasions. That legal sanctions will come, perhaps soon, prescribing what is right in some matters now left to conscience, I have no doubt. Among the first of them will be those which provide that whenever the public is asked to subscribe for mining stock it must bear the hall-mark of a qualified engineer.

The constituency of the mining engineer is the mining community, and while his endeavor is always in the direction of elevating the industry he serves to as high a commercial plane as is possible, yet it is true that the constituency to which he devotes his life's work is one in which the speculator largely predominates, and necessarily so. That the public will speculate is no fault of his. The community should welcome the man who on chance, puts his money into what becomes a fruitful mine.

Speculative Element in Mining.

It has been said that "mining is, was and will be to the end of time a sane speculation or a silly gamble, but never an investment; the element of risk is never eliminated and any statement to that effect, as regards a particular mine, is made by a charlatan or a fool." To part of his statement anyone will subscribe. The most serious objection made to it, was that it was too frank an admission of the truth. But as successful mining is based on the application of science to that industry the nearer we get to the truth the less danger we run and the closer we come to solution of the mining problem, how to dig ore and make it pay.

Of the two capacities in which the mining engineer may be engaged whether as mine valuator, or to advise on development, equipment and operation of mines and metallurgical works, the former alone calls for attention; because in connection with the other what were formerly matters of conscience, such as taking what was called the "customary commission," a percentage paid on the price of machinery and supplies recommended by him, are now penalized by statute.

As a mine valuator, the engineer will find his duties are divisible into two sets, those business methods concerning which a bargain can be reached satisfactory to all concerned, consistent with through and honest work; and those business ethics in which the exercise of his moral faculties is called into play. To the latter only I intend to direct your attention.

When a client selects an engineer, such reputation as the engineer has gained is assumed to have a market value and the price is offered him on that basis. Once engaged, the engineer's fiduciary relation, outside of his duty to himself, is two fold, he is trustee for his employer as well as such of the investing public as may be asked on the strength of his report to invest in the shares of the company for whom it is made. The engineer should therefore never make a report for a contingent fee, a fee in stock, which depends for its value upon his report in creating confidence in the public mind. Such conditions cannot but influence the judgment of the maker of the report.

When outfitting, the question comes up, what part of the engineer's equipment can be charged to the client. The engineer is assumed to be equiped and outfitted for the work pertaining to mine examination. A charge should only be made for such equipment as is either consumed in the work or returned to the employer. If special equipment is needed for the particular task the client must provide it.

On the journey the engineer is entitled to first class passages on trains and boats and to the best accommodation at hotels. But the expense account is not one which admits of personal gain. It is always desirable for him to travel as a gentleman and not appear cheap in any way. But to travel by one class and charge for a higher is petty larceny. Opinions differ as to the spending of money on entertainment for the purpose of obtaining pertinent information, and although the engineer is sent to secure information and trusted to use his discretion, it is better not to do this at the expense of the client unless it is so agreed.

Personal Interest in Reports.

The engineer's examination may indicate that the shares should be worth more than they are selling for on the market and he asks himself, "Is it fair to buy the company's shares before my report is turned in, or, if not, is it right to do so afterwards?" This means buying shares on information gained at the client's expense. To use his broker before advising his client of his conclusions would be unpardonable. The man of capital does not employ the engineer with the idea that a business trust is to be turned into a personal coup. As was said of the contingent fee, personal interest constitudes a bias in the engineer's opinion. An engineer cannot mix up in a stock deal at the time of reporting without directly laying himself open to the imputation of dishonesty.

It is better too for the engineer not to buy shares after his report is in. In may be that his buying or selling of shares would work a distinct injury to his clients as he may not be informed as to the object of his employment. It is better, on the whole, to leave the stock market entirely alone when engaged in confidential work of this nature.

But it may be asked: should an engineer be precluded from buying a good stock because his examination and personal knowledge shows it to be good? Must he al- in that district. This information is the exclusive property of the client until such time as it no longer

* Address delivered before the Engineering Society, School of Mining, Kingston, Ont.

ways buy stock in something he knows nothing about personally? Is it not an excellent way of showing his confidence in his own judgment, to buy the shares? The confidential relation of engineer and client does not end with turning in the report, and a conscientious man will therefore neither buy nor sell shares. If it be done with the knowledge and consent of the employer, there is less objection. But the unwisdom of taking shares even under these conditions is well illustrated by what has actually happened. The shares go up, can the engineer sell when he thinks they have gone high enough without affecting his employer's position?

In the case of Yukon Gold, while the owner was making a market price for the shares, the engineer who had made the report was selling. The engineer's information on which he sold belonged to his client, and his being a seller must affect the market. Whatever the impropriety of the owner's course, the engineer was using information he had been paid to give his client to the client's disadvantage.

In any case such shares are dangerous to the young engineer who has not learned that stock manipulation is one thing and the value of stock based on the merits of the mine is another thing and not necessarily in accord. The stimulus of a share gamble is the most insidious lure he faces in the early stages of his career. A good authority has said "it has spoilt many fine fellows, is has ruined twenty times as many good engineers as it has enriched."

Being in a district, it is not legitimate for the engineer to take advantage of his presence there to examine and perhaps option mining properties for himself, or to examine and report on properties for others. Even though no time is lost that properly belongs to his employer?

It certainly is not legitimate to take advantage of his presence in a district to report on properties for other parties in the absence of specific agreement to that effect. Apart from such questions as possible competition, he is there on his client's money. It is proper and advisable to see as much of a district as possible but not to use the information for personal gain; if the engineer's examination show that the properties in the district are of value the information belongs first to his client.

The acquisition of property or options over property on his own behalf would be liable to severe criticism, and place the engineer in a very false position, even if acting in perfect good faith. An engineer returning from the Portland Canal where he has made an examination, finds himself at Prince Rupert and no boat due for a week. He takes a trip to a nearby district, examines and options a prospect, paying all expenses himself and returns in time for the boat. His clients have lost nothing but as they have paid the expense of his trip to Prince Rupert they should have the opportunity to take the prospect.

If after full disclosure and report the client consents to his keeping any part of what he has got then it is quite proper to do so.

Publicity and Repetition.

When the engineer has returned home he is concerned to know if he may properly publish in technical periodicals a description of the district visited, giving general information of the conditions obtaining there, the topographical and geological features and conclusion concerning the possibilites of successful mining. This is a question for his client, not for himself. It is in all cases proper to ask permission to publish articles, the material for which is gathered at the expense of another. All general information on any district has an important bearing on any investment concerns his interests. When he permits it, is soon enough to give it to the public.

The answer the engineer is to make to the questions submitted to him neccessarily depends on the form of the questions. The man who desires a report wants to know whether the information obtainable justifies his putting up the money that is asked. The demand is for something more than a judgment which hedges. The responsibility should be faced if a judgment is required on the commercial question involved.

If an opinion can be expressed in one word, he should use it, but if he can't he should say so. He is entitled to say he does "not know," when the conditions are such as to leave the matter in doubt. He may condemn a substantially good mine being unable to get sufficient information to warrant a favorable report, and will be right in doing so. The positive answer should be given only when all the conditions justify it. If there are any reasonable doubts, they should be expressed, leaving the client to take the risk.

Every form of disguised advertising is to be avoided. This is an age of commentary, but many of the reviews of professional work to be found in our literature today on the subject of mining engineering have for their purpose only the aggrandizement of the reviewer. This serves no good purpose and stamps the man. It fails in its object—not a very noble one—to bring the writer into prominence at the expense of the more proficient. An engineer is entitled to just such standing as his merits justify, and he is unworthy who seeks notoriety through the medium of criticism of honest and creditable work.

Adherence to such a code of honor as I have endeavored to outline should bring success to the young engineer. A fine sensitiveness is rarely appreciated at its value by those who employ professional services, and confident assurance often commands respect where modest merit is sometimes distrusted.

Cerro de Pasco.

The Cerro de Pasco mines are located at the town of the same name in Peru, over 14,000 feet above the sea level. Since the inauguration of the present enterprise in 1902 there has been an investment of fully $25,000,000.

History records that silver was discovered at Cerro de Pasco in 1630 and the mines produced to the close of the nineteenth century about 450,000,000 ounces from 40,000,000 tons of silver and copper ore, nearly all extracted by hand work and carried three to six miles on the backs of llamas to primitive smelters, whence the silver bullion was transported by llamas 200 miles to Lima, until 1870. Formerly only the ores of 25 per cent. to 40 per cent. copper were shipped.

The introduction of modern machinery and methods, albeit under many discouraging handicaps, has resulted in the building up of an enterprise capable of producing over 70,000,000 pounds of copper per annum.

An official of the company gives the following figures of output for the past three years, November and December, 1914, being estimated:

1912—45,272,000 pounds fine copper, net refinery returns.

1913—43,856,000 pounds fine copper, net refinery returns.

1914—42,000,000 pounds fine copper, net refinery returns.

The company's smelter has a capacity when running full of at least 6,000,000 pounds per month. Had it not been for the war it was hoped to reach this capacity the last half of this year. At the present time the company is shipping at the rate of 2,500,000 pounds per month or about 40 per cent. capacity.

PATIO

In sinking a shaft in the Lake Superior district it is asserted that the speed of sinking was increased by 55 per cent by the use of a blasting box. Instead of using a long fuse for each hole, one long fuse was used to ignite the powder in the box and this in turn ignited all the short fuses connecting the holes with the box.

The greatest difficulty arising from the vitiation of air in mines by decaying timbers, is in stopes where the timber is required to last only a short time. The decay does not set in until after the timber has served its purpose of sustaining a temporary load. A great quantity of timber accumulates in a mat following the stope downward in certain systems of mining. The slow combustion of this mat makes the troublesome heat and bad air in the working places.

In shallow mines it is possible to use timber or other supports to hold up the actual weight of the rock above the excavation. But at great depths no material can withstand the tendency of the mass to move downward and fill the opening. It is, however, possible and practicable to support pieces which have broken off the main rock mass. This is the purpose of timbering at great depth, to hold up temporarily loose end fragments, and for this purpose yielding supports are more useful than rigid ones. A wooden stull or prop set in the usual way with a hitch in the footwall and a wedge against the hanging wall, yields little to slow closing up movement before it buckles and becomes useless. A support made of a piece of timber set on end and with more or less blocking at the top and bottom will yield until the blocking is crushed to pulp, thus greatly prolonging its life. Concrete yields even less than timber on end and at the least movement it fails suddenly without warning. Steel has more yielding quality, but its replacement or repair is much more difficult than in the case of wood.

Ordinary blasting powders not affected by the cold but in warm damp weather it is liable to take up moisture and thus lose strength. It is made up largely of nitrate of soda with 10 to 15 per cent sulphur and charcoal and contains no liquid ingredient. Ordinary handling and shaking in transportation does not affect it. It is the nitrate of soda that attracts the moisture in the air.

The mills of the Consolidated Goldfields of South Africa which controls a group of mines, extracted during the past year 95.014 per cent of the values in the ore. The manager's report states that under existing conditions, and in accordance with the principle of obtaining the maximum profit per ton of ore treated, it would appear that the economic limit of extraction has been reached, and that any further increase in percentage extraction would cost more than the value of the gold recovered.

Tin smelting is theretically a simple operation. The concentrates usually handled are almost pure tin oxide which reduces readily even in a small crucible, and the melting point of tin is low. Yet the smelting charges for tin ore are high, and no visitors are allowed in tin-smelting works throughout the world whether in England, Germany or the Far East. Smelting of tin in Bolivia has been abandoned, the bars containing only about 97 per cent metallic tin, while the best tin in the market carries about 99.9 per cent tin. This seems to point to the existence of some detail in tin smelting upon which the success of the operation hinges, and which it is desired to keep secret.

In the early days of iron smelting the iron was allowed to run out of the furnace and cool in pools in the sand. When the output increased a runner was formed in the sand to lead the molten metal away, and short lateral runners were made to connect with the main runner in which the iron cooled in masses of convenient size. The general appearance of the whole arrangement was something like a sow with a row of suckling pigs. This is the origin of the name pig iron. The runner from which the metal flows into the pig moulds is still known as the "sow."

The total number of mines producing gold and silver in the United States and Alaska during the year 1913 was 5276. There were 1774 placer mines and 3502 of the other sort.

It has long been known that in roasting galena a mixture of litharge and lead sulphate is obtained. Demwolf, who during the past year studied the reaction in Germany, found that at temperatures below 450 deg. C. lead sulphatet is chiefly formed, and that in the presence of a catalysing agent the whole of the sulphide may be changed into the sulphate. He also determined that the more the temperature rises above 450 deg. the larger the proportion of oxide formed and that above 750 deg. C. the reaction between undecomposed lead sulphide and sulphate as well as the oxide will liberate metallic lead which will be oxidized to litharge.

Blast roasting of lead-bearing mixtures has increased to such an extent that it has almost completely replaced the older methods of roasting. Different apparatus has been used, but the great rivals in equipment for blast roasting are the Huntington-Heberlein pot and the Dwight Lloyd straigth line machine. Advantages are claimed for each, but careful comparisons made in the same works have shown little superiority in either system.

New Publications.

American Electricians Handbook. By Terrell Croft. McGraw-Hill Book Co., New York. Leather; 711 pages, 4½×7 illustrated; tables. Price $3.00.

Transformer Practice. By Wm. T. Taylor. McGraw-Hill Book Co., New York. Second Edition. Cloth; 278 pages, 6¼×9½ in.; 191 illustrations. Price, $2.50.

Grand Gulch Mining Region, Mojave Co., Arizona. By J. M. Hill. Bulletin U. S. Geol. Survey, No. 580-D. 5 figs., 56 pages, with bibliography of copper ores of the "Red Beds."

Lode Mining in the Ketchikan Region of Alaska. By Philip S. Smith. U. S. Geol. Survey, Bulletin 592-B, pp. 75-94. Describes briefly the various districts of the Ketchikan region.

Elementary Chemical Microscopy, by Emile M. Chamot, B. S., Ph. D., Professor of Sanitary Chemistry and Toxicology, Cornell University. 410 pages, 6×9, 139 figures, Cloth, $3.00. John Wiley & Sons, Inc., New York City.

Examination of Hydrocarbon Oils and of Saponifiable Fats and Waxes, by Prof. D. Holder, Sub-Director of the Royal Bureau for Testing Materials of Berlin-Lichterfelde Docent at the Technische Hochschule, Berlin. Authorized translation from the 4th German Edition, by Edw. Mueller, Ph. D. Professor of Inorganic Chemistry, Massachussetts Institute of Technology. 496 pages, 6×9, 115 figures, Cloth, $5.00. John Wiley & Sons, Inc., New York City.

Constant-Voltage Transmission, by Herbert B. Dwight, B. Sc., Electrical Engineer, Canadian Westinghouse Co., 122 pages, 5¼ × 7, illustrated, Cloth, $1.25. John Wiley & Sons, Inc., New York City.

Materials of Construction, Their Manufacture, Properties and Uses, by Adelbert P. Mills, M. S., C. E. Assistant Professor of Materials, College of Civil Engineering, Cornell University, 682 pages, 6×9, 346 figures, cloth, $4.50 John Wiley & Sons, Inc., New York City.

New details are continually being added by geologists to the known history of the earth, including the development of plants and animals. However, that history, which is recorded in the rocks, is still fragmentary, like a badly mutilated book. One of the great defects in the record in the Atlantic and Gulf Coastal Plain regions of the United States is the absence of the later part of the Cretaceous and the early part of the Eocene chapters

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—perhaps 8 to 10 million years ago. A report recently issued by the Geological Survey as Professional Paper 90-J, entitled "The Cretaceous-Eocene Contact in the Atlantic and Gulf Coastal Plain," by L. W. Stephenson, discusses this missing part of the record and shows that the break must cover a very long period of time. It is known that at that time the continents were at least as large as and probably larger than they are now, and the oceans were accordingly smaller. Any rocks that were then formed in the sea seem to have been weathered and washed away.

Hundreds of kinds of plants and animals that lived before and hundreds that lived after this great period are known, but not one which lived during the period. Strange to say, few if any of the species which existed before the unknown period lived through it. It is like a play in which the places of one act remain the same as in the preceding but the characters are all new, and yet many of the new players resemble the old ones so much that one is compelled to admit that they are close relatives. In each of the States bordering the Atlantic Ocean, south of New York, and the Gulf of Mexico, are layers of rock which were formed before and after the period whose record is missing. In these layers are entombed sea shells of many kinds, but apparently not one species lived through from Cretaceous to Eocene time.

A copy of the report may be obtained free on application to the Director of the Geological Survey, Washington, D. C.

The United States Bureau of Mines has just issued a small edition of Bulletin 85, "Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1911 to 1913," by Arno C. Fieldner, Howard I. Smith, Albert H. Fay and Samuel Sanford. The present bulletin presents analyses and descriptions of samples of coal collected from many mines throughout the entire country. In order that the material in this bulletin may be made to supplement that presented in Bulletin 22, "Analyses of Coals in the United States" the same plan of geographical classification has been followed, the analyses and descriptions of the samples being grouped in alphabetical order according to the state, country, and town near which the mines or prospects sampled are situated.

Bulletin 22 was said to be the most comprehensive publication ever issued on the coal of the United States and the new bulletin is an extension of that work. So great was the demand for Bulletin 22, the free edition was exhausted a few weeks after its issuance. At the present time the only way to obtain a copy of Bulletin 22 is through the Superintendent of Documents, Government Printing Office, Washington, D. C. who sells the publication at eighty-five cents.

In Bulletin 85 are chapters on the collection of samples, the method of mine sampling followed by the Bureau of Mines, the relation of mine samples to commercial shipments, methods for the determination of moisture, ash, volatile matter, fixed carbon, and sulphur. Copies of this bulletin may be obtained as long as the free edition remains in stock by addressing the Director of the Bureau of Mines Washington, D. C.

PERSONALS.

T. Skewes Saunders, assistant manager of Las Dos Estrellas Mining Co., El Oro, Mex., has been spending some time in Mexico City.

Percy E. Holme, cyanide superintendent of El Oro mill, has returned to El Oro.

C. W. Van Law, manager of the Real del Monte company, after several trials has succeeded in reaching Vera Cruz en route to the States.

R. M. Raymond, recently elected president of the American Society of Mexico, spent several days last month in El Oro.

Dan Doyle, of El Oro, was a Mexico City visitor last month.

W. H. Yeandle has left Mexico city for the States. His headquarters will be at Atlanta, Ga.

A. J. Eveland, of the Cia. de Santa Gertrudis, Pachuca; Glen Anderson, manager of the La Lucha property at Tlalpujahua, Mich.; T. Patterson, of Pachuca, and Bond Coleman, of El Oro, are visiting in Mexico City.

Joe Seaver, of Pachuca, who left some time ago to join the British forces, is according to latest reports, still in London.

Percy Stockdale has returned to Cinco Minas, Magdalena, Jalisco.

Arthur Hunter is operating a smelter at Taxco, Gro.

P. A. Babb has returned from a trip to Pachuca.

Wm. Crossley, formerly of Chihuahua, is general manager of Prestea Block A., Ltd., Gold Coast, West Africa.

Stanley Brown is at Chuquicamate, Chile.

D. L. H. Forbes, formerly of Sonora, is with the Chile Exploration Co., at Chuquicamate, Chile.

W. Motherwell, who has been experimenting with flotation processes at the Moctezuma Copper company's mill, Sonora, has finished his work and is at Douglas, Arizona.

A. E. Drucker is with the Frontino & Bolivia Gold Mining Co., Bolivia, superintending the construction and starting of a 30-stamp mill. It is expected the work will occupy nine months.

Chas. S. Witherell is superintendent of reduction for the Chile Exploration Co. Leonard M. Green is in charge of leaching, Maurice R. Thompson in charge of electrolytic tank house and Otto Koch in charge of the smelting and milling plant.

Edw. H. Emerson is manager of El Cobre mine, Santiago de Cuba.

Baylies C. Clark has returned to Sutter Creek, Calif., from Antioquia, Colombia, where for the past year he has been examining placer properties for the Breitung company.

END OF THE TRAIL.

Charles A. Schieren, founder of the Charles A. Schieren Belting Company died in New York City March 10, 1915, at the age of seventy three.

TRADE NOTES

Sangamo Electric Co., Springfield, Ill., has issued Bulletin No. 40, 32 pages, illustrated, describing Alternating-Current Watthour Meters, Single Phase and Polyphase. Both instruments are built for voltages from 100 to 2200 volts.

Manhattan Rubber Mfg. Co., Passaic, N. J. The company's general catalogue of 417 pages presents a large line of mechanical rubber goods, including belts, both transmission and conveyor, hose for water, chemicals, etc.

Denver Hydro Co., Denver, Colo. The Denver Hydro Air Compressor is illustrated and attention called to its essential features in a four page folder recently issued by this company.

Morgan Engineering Co., Alliance, Ohio. The Argentine government has placed an order with this concern for a 150-ton short span gantry crane.

Cutler-Hammer Mgf. Co., Milwaukee, Wis. Magnetic switches is the title of a recent 16 page catalogue issued by this company.

Cleveland Rock Drill Co., Cleveland, Ohio. Bulletin No. 33 treats of the Cleveland Hand Rotated Hammer drills manufactured by the company.

Morse Bros. Machinery & Supply Co., Denver, Colo. This concern recently furnished a complete hoisting and compressor outfit, together with drills and appurtenances, to the Buffalo-New Mexico Mining Co., in New Mexico. Also a 50-ton concentrating mill to the Granite Tunnel Co., Granite, Colo.

Chard & Howe, New York City, has placed on the market a new paste for making up pipe joints. It is adapted to steam, oil, water, air, gas, and ammonia plants and piping; has three times the bulk of red lead, is not poisonous and does not harden or dry out.

Erie Pump & Engine Works, Erie, Pa., reports that it recentiy has been consolidated with the Northern Equipment Co. The new name is the Erie Pump & Equipment Co.

The largest induction motor, shaft hoist equipment in America was placed in operation last November at Lansford, Pennsylvania, by the General Electric Co., of Schenectady, New York. The driving motor is rated at 750-HP. 300 r.p.m., 3-phaze, 25 cycle, and drives through a single reduction gear. Positive control of the hoisting speed is secured by means of an improved type of liquid rheostat and high-tension air-brakes contractors, the motor circuit being 2300 volts. This hoist serves a 600-ft. vertical shaft hoisting 11,500 lb. per trip at the rate of 90 trips per hour, with a maximum rope speed of approximately 1600 ft. per minute. The liquid rheostat was developed primarily for mine hoist service, and insures safe operation at quick reversal. It employs two sets of fixed electrodes at different elevations. One set is widely spaced, while the other set has large electrode areas and has small spacing in order to obtain a very low final slip. The two sets of electrodes are connected in parallel after the electrolyte has reached a certain level corresponding to a predetermined decrease in rotor voltage. All parts of the rheostat itself are stationary, thus insuring absolute reliability. The electrolyte level is varied through the operation of a movable weir and a small motor driven pump.

Webster Mfg. Co., Tiffin, Ohio. A recent leaflet illustrates the car pullers manufactured by this company. They are made in various forms and adapted to a wide variety of uses.

The Dodge Sales & Engineering Co., Mishawaka, Ind., has been organized and incorporated to distribute all of the products of the Dodge Mfg. Co.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1913	1914	1912	1913	1814
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61 642	57 506	27.196	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59 217	59.490	58.519	28.284	27.416	26.958
May	60.880	60 361	58 175	28.038	27 825	26.704
June	61.290	58 990	58 471	28.215	27 199	26 918
July	60.654	58 721	54 678	27 919	27 074	25.219
August	61 606	59 293	54 344	28.375	27 335	25 979
September	63.078	60 640	53 290	29.088	27 986	24 260
October	63.471	80 793	50.654	29.299	28 085	25 198
November	62.792	58.885	49.082	29.012	27.263	22.703
December	63.365	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4 171	4.011	17.114	19 665
February	4.325	4.018	4.175	3.937	16.550	19.606
March	4.327	3.870	4 177	3.850	15.977	19 651
April	4.381	3 810	4.242	3.683	17.650	18 225
May	4.349	3 900	4 208	3.863	18.698	18 503
June	4 325	3 900	4 190	3 810	20 228	18 411
July	4 353	3 891	4 223	3 7 8	20 038	19 041
August	4 624	3 875	4 550	3 715	20 406	
September	4 998	3 828	4 579	3 658	20 648	
October	4 402	3 5 8	4 253	3 564	20 312	
November	4 293	3.683	4 143	3.581	19 364	18.560
December	4.047		3.921		17.796	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14 971	14.491	15.253	14.946	65.519	65.259
March	14 713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15 436	63.996	15.738	.....	68.807	67.786
June	14 672	61.603	14.871	.....	67.140	66.274
July	14 190	13.223	14.563	.....	64.186	64.955
August	15.400	.....	15.804	.....	69 200	53.227
September	18 328	.....	18 798	.....	73 125	.....
October	18 337		18.913	.....	73 383	.....
November	15 182	11.739	18 022	.....	68 275	.....
December	14.224	.....	4.904	.....	65 228	.....
Total	15.269	.....	15.680	.....	68.335	.....

New York, cents per pound. London, pounds sterling per long ton of standard copper.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1931	1914
January	6 931	5 252	6.854	5.112	26.114	
February	6 239	5.377	6.089	5.2	25.338	21.583
March	6.078	5.220	5 92	5.100	24.605	21.413
April	5 641	5.113	5 491	4.963	27.313	21.460
May	5 406	5.074	5 25	4.924	24 583	21.569
June	5 124	5.000	4 974	4.85	22 143	21 393
July	5 278	4.920	5 126	4 77	20 592	21.345
August	5 658	5.568	5 501	5 4 1	20 706	21.568
September	5 694	5.38	5 444	4 23	21 148	
October	5 340	4 979	5.181	4.150	20 614	
November	5 229	5.112	5 08	4 962	20.561	
December	5.156		5.0		21.214	25.013
Year	5.64		5.504		2.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

TIN

Month	New York		London	
	1913	1814	1913	1914
January	50.298	37.779	238 273	171.905
February	48.766	39 830	220.140	181 565
March	46.832	38.038	213.615	173.819
April	49.115	36 154	224.159	183 863
May	49.068	33.369	224.143	150 702
June	44.820	30 77	207.208	148 321
July	40.260	31.707	183.511	142.517
August	41.582		188.731	.....
September	42.410	32 875	193.074	.....
October	40.462	30.284	181.837	.....
November	39.810	33.304	180.569	139.391
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.51	July	
February	51 25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

AMERICAN SOCIETY OF MEXICO.

The Society of the American Colony of Mexico City has been reorganized on broader lines, under the name of "The American Society of Mexico."

At a mass meeting recently held in the City of Mexico a new Board of Directors was elected, together with the following named officers: President: R. M. Raymond; Vice President, Dr. Sidney Ulfelder; Secretary, J. D. Helm; and Treasurer S. S. Conger.

At a later meeting the Society adopted a new Constitution and By Laws, providing for permanent organization. This is broad in scope, to cover present and future needs.

The object of the Society as stated, is to promote the welfare of the American residents of the Republic of Mexico. Among other powers the Society is authorized to take cognizance of and act upon all subjects of general interest of its members; to promote and establish mutual cooperative relations; to cooperate with and assist other American institutions of Mexico; to provide, when expedient, a home or house for the accommodation of its members; and to acquire property when desirable for the uses of the Society.

All properly recommended nationals of the United States of America, either men or women residents of the Republic of Mexico, may become members of the Society by signing cards of registration.

The principal office of the Society is to be in the City of Mexico, but branch offices may be established elsewhere.

Heretofore the membership has been limited to men, but in the reorganization the women are invited to join. The present membership of about 1,300 will at once be largely increased.

A cordial invitation is extended to all Americans, men and women, throughout the Republic to identify themselves with this movement for mutual benefit. Naturally the Society will be non-political and non-sectarian. It is also entirely democratic and requires of applicants nothing more than a recommendation as to good character.

It is hoped that Americans of all occupations throughout the Republic will recognize the importance of such an organization and will identify themselves with it. If they do real benefits can be secured for all concerned.

There is need for a strong Society and better opportunities for acquaintance than have heretofere existed among the Americans so widely scattered over this great and undeveloped country. It is important that more and reliable information be had of the Americans living in Mexico, and that a common channel of communication be provided for various purposes. This will give an opportunity for united expression of sentiment and united action in matters relating to the common good. It will make possible a registration of American residents that has not existed heretofore.

When the plans are fully developed in the course of time the Society will be able to provide a Club or meeting place for Americans from all parts of the Republic when they visit the capital; meantime it can be made useful as a source of information to non-resident members.

All who feel an interest are invited to correspond with.

J. D. HELM, Secretary.
408 LA MUTUA, MEXICO, D. F.

One of the most interesting of the findings of the Selby Smelter Commission, appointed to inquire into the smoke question of the smelter in California was in effect that sulphurous gases from Dwight Lloyd roasters could be concentrated by recirculation to the extent of 7.5 per cent sulphur dioxide, making it possible to produce sulphuric acid from the gas.

It is, of course, his duty and to his credit for the metallurgist to do all he can to secure the maximum possible extraction, but the maximum possible extraction and the extraction that will pay the maximum dividend are not by any means the same thing. The lower the grade of the ore, in general terms, the greater the difference there will be between the maximum percentage extraction obtained and the maximum economic extraction. The percentage extraction that will pay will be relatively lower as the grade of ore is lower.

A new explanation of the action of calcium fluoride, or fluorspar, in making basic slags more fluid gives to fluorine, which is supposed to carry off silica as a gas, the role of carrier between the lime and silica both fused with difficulty. If the fluorine actually removed the silica in the form of a gas the basic slags would become still more basic and, therefore, less fluid. As a matter of fact the slag becomes more fluid, and it appears that the fluorine serves merely to make the silica more mobile and to bring it into more ready combination with the lime to form a fusible salg.

A feature of the continuous counter-current decantation system is the small amount of power required. In a 90-ton plant in Nevada 10 horse power is sufficient to operate three agitators of the Dorr type, five thickeners, two solution pumps and five diaphragm pumps.

The difference between the ordinary arc light and the flaming arc is that in the ordinary arc lamp the end of one of the carbon electrode itself is highly heated and gives off the light, while in the flaming arcs the arc itself becomes luminous by reason of chemical substances in the carbons and volatilized by the intense heat. Calcium fluoride is the most common substance added to produce a flaming arc. It gives an intensely yellow light. Other substances are added to correct the yellow tint. These substances are either mixed with the carbon mass before molding and baking or inserted in a hollow ore in the carbons. A number of flame colors may be produced by selecting the flaming substances. White flame carbons contain mostly rare earths. There are also red, green and blue flame carbons. The red and green are little used, except for advertising purposes, while the blue is used for producing the ultra-violet rays useful in medicine.

A case is on record of a Dorr classifier which operated nearly four years with a repair cost of $5.00 and a power consumption of ¼ horsepower.

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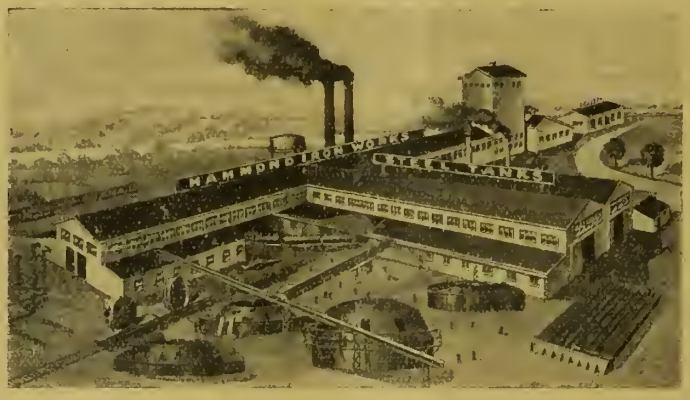

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Empleo del Serrín para la producción del Gas Pobre.

Entre las innumerables aplicaciones que tienen el serrín y los residuos de madera, varias de las cuales son ya conocidas de nuestros lectores, merece consignarse la extracción de gas pobre de los residuos y desperdicios que dejan las fábricas de aserrar maderas, el cual puede muy bien utilizarse en las mismas para la producción de fuerza motriz.

Una instalación de esta índole establecida en un aserradero de New-Castle-on-Tyne consta de un motor de gas de 50 caballos alimentado por un gasógeno cilíndrico vertical. Al calentarse el serrín por la parte baja, desprende varios gases que, después de pasar por una serie de tubos, van a un depósito condensador que contiene cok de alto horno, en el cual se purifica el gas que después pasa por otro depósito de serrín de donde va al motor.

Los residuos del serrín son un carbón muy fino y alquitrán de muy buena calidad.

Este procedimiento permite obtener fuerza motriz económica en los sitios en que, como el mencionado, se dispone de desperdicios de madera en suficiente cantidad y bajo coste.

Cuando se está desvastando una pieza de metal, especialmente si es dúctil y fibrosa, conviene tener sobre el banco un trapo empapado en aceite, y pasar por ahí, de cuando en cuando, el cincel.

*Recursos Mineros de la Región Norte de la Costa Occidental de la Baja California.**

La población.

El Territorio de la Baja California es una de las Entidades menos pobladas entre todos los Estados y Territorios de la República, y precisamente el Distrito Norte al cual pertenece la zona estudiada por nosotros, es el que tiene menos habitantes. Un censo seguro todavía no existe; el pequeño número de habitantes, la falta de comunicaciones, la circunstancia de que ciudades y pueblos de relativa importancia existen sólo en número muy reducido mientras que la mayoría de los habitantes vive en ranchos aislados, dificultan mucho el establecimiento de un censo aproximadamente exacto. Además, hay que tomar en consideración que la población fluctúa muchísimo en tales países poco habitados. Los ganaderos de la sierra cambian con mucha frecuencia su domicilio, lo que depende de la cantidad de alimentos que encuentran los animales; más notable todavía es la fluctuación de la población en los distritos mineros. Al tiempo del descubrimiento de los placeres de oro de Real del Castillo, de Calamahí, de Santa Clara, hubo una inmigración enorme de gente para estos lugares; cuando los placeres empezaban a agotarse, la gente emigró poco a poco, de modo que tales lugares quedan al fin completamente abandonados y en ruinas.

Lo que hemos dicho acerca de la fluctuación de la población no se refiere solamente a los placeres sino también a las minas. Según las experiencias obtenidas en Baja California, se puede confirmar que las minas de oro de aquel Territorio en lo general, no son muy duraderas, y que no producen durante un gran número de años, pues parece que en una profundidad no muy grande todas aquellas vetas de cuarzo aurífero se empobrecen rápidamente. Es una regla general que en lugares donde se han agotado los placeres, los mineros tratan de explotar las vetas auríferas. Esta explotación de las vetas se ha hecho también en las diferentes localidades auríferas de Baja California; pero en la mayor parte de estos lugares ya se han abandonado en la actualidad las minas que durante algún tiempo daban resultados bastante favorables. En Calamahí, ya no trabaja ninguna de las minas que estaban en bonanza durante los años de 1882 a 1890; la consecuencia es que en Calamahí se han quedado únicamente ganaderos que tienen su ganado en las sierras alrededor de la población. En Campo Alemán sólo existe una mina, "El Arco," que fue trabajada hasta el año pasado y la cual quizá se se seguirá explotando todavía durante algunos años. En Real del Castillo tampoco existe ya mina alguna en explotación, sólo en el distrito minero de Zaragoza, cerca de Real del Castillo, se continúan trabajando algunas minas de oro. Según los informes que pudimos obtener, las minas de oro en el Distrito de Alamos están actualmente paradas, pero es muy posible que algunas de ellas vuelvan a explotarse.

Cosa semejante ha pasado también con las minas de cobre, aunque por diferentes causas. Todas las minas de cobre que durante algún tiempo fueron explotadas en el Norte de la Península, estan abandonadas en la actualidad, en parte porque desde el principio no tenían valor alguno, en parte porque la baja del precio que sufrió el cobre las obligó a interrumpir sus trabajos; discutiremos estas causas de una manera mas detallada en un capitulo posterior. Aquí se trata únicamente de demostrar que la suspensión frecuente de los trabajos mineros ha ocasionado una fluctuación muy considerable de la población. Parte de la población minera seguramente emigró del Territorio, especialmente los gambusinos extranjeros que habian trabajado en los placeres; otra parte fué a nuevos distritos mineros y una tercera parte quedó en el lugar dedicándose al cultivo del suelo. Ya durante el trabajo de las minas se había formado un núcleo de agricultores en los alrededores para suministrar a la población minera los alimentos necesarios. En lo general los ranchos establecidos entonces han continuado sus labores y aun se han formado varios nuevos allí donde han podido obtener un mercado para sus productos. Un ejemplo para esto lo ofrece Real del Castillo; en la ciudad vemos actualmente docenas de casas bien construídas, pero enteramente vacías y abandonadas, mientras que en los alrededores existen varios ranchos en estado floreciente que han encontrado en la ciudad de Ensenada un mercado nuevo cuya capacidad de consumo aumenta diariamente y que ya hasta han comenzado a exportar parte de sus productos.

El abandono de las minas ha tenido una influencia casi todavía más funesta en Calamahí. Ya hemos dicho que los

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* Parergones del Instituto Geológico de México.

habitantes se han dedicado allí a la ganadería, para lo cual han encontrado un mercado en las minas de El Boleo, no obstante de ser la comunicación con aquel lugar bastante difícil. Pero en este caso no solamente Calamahí se ha despoblado en gran parte sino que se ha abandonado por completo el puerto de Santo Domingo que en tiempos anteriores estaba tan frecuentado, que el Gobierno Federal estableció allí una aduana. Hoy encontramos en el puerto de Santo Domingo solamentet una serie de casas de madera completamente abandonadas y en ruinas y algunas embarcaciones varadas. Así es que el abandono de las minas de Calamahí no solamente ha causado la emigración de la mayor parte de los habitantes sino también ha tenido una influencia sobre los medios de comunicación ocasionando la ruina de un puerto en otros tiempos muy útil para toda la región.

Una emigración de sus habitantes ha sufrido también el pueblo de Santa Catarina a causa de la decadencia de las minas de cobre en sus alrededores, aunque allí el efecto ha sido paralizado en parte por el establecimiento de las canteras de ónix en las cuales muchos de los habitantes de Santa Catarina han encontrado trabajo. Otras minas han quedado completamente sin habitantes o solamente se encuentran allí actualmente un velador con su familia. A esta clase pertenecen la mina del Sueño del Rancho de los Alisos al Sur de Tijuana, la mina de Santa Rosa cerca de la exmisión de San Miguel, el Campo Jordán en el camino de Ensenada a Real del Castillo, la mina Marguerite cerca de Santo Tomás, la mina de la Delfina cerca de la ex-misión de San Vicente, la mina de San Fernando cerca de la exmisión de San Fernando, la mina de Julio César y la de Santa María entre Santa Catarina y el rancho de Santa María, y otras muchas más. En casi todos estos lugares ha habido durante algún tiempo una población relativamente grande que después ha emigrado por completo.

La inmigración, durante el régimen colonial, ha sido muy pequeña. Bancroft (1) ha dado una lista de los habitantes de las Californias que inmigraron en los años 1769-1800; esta lista contiene más de 1,700 hombres. Naturalmente la litsa no es completa, pero de todos modos indica que la población de California era muy pequeña. Descendientes de estos antiguos colonos que probablemente en su mayor parte vivían en la Alta California, existen probablemente todavía en la actualidad en la Baja California. A estos pertenecen los Villavicencio, los Ibarra, los Arce, los Castro, los Duarte, los Machado y otros más.

Seguramente, después del regimen colonial, la inmigración no ha aumentado de un modo notable; sin duda llegaron de vez en cuando algunas personas que se establecieron en la Península. Entre éstas hubo también algunos extranjeros que en parte habían pertenecido a la tripulación de algunos buques. Estos se radicaron en diferentes partes, se casaron y sus descendientes habitan actualmente en numerosos ranchos. Esto explica que en el Norte entre Ensenada y Tijuana, existen numerosos mexicanos con nombres extranjeros como los Gilbert y los Crohsthwaite. En 1880 comenzó una inmigración algo más crecida a causa del descubrimiento de los placeres de oro en Real del Castillo y más tarde en otros lugares. La mayor parte de la gente inmigrada en esta ocasión no quedó radicada en el país sino emigró después de que se habían agotado los placeres.

Después de este tiempo la inmigración ha sido muy poco numerosa; desde el año de 1906 han empezado a llegar familias rusas en un número de varios centenares. Estos se han establecido al principio principalmente en el valle de Guadalupe, al Norte de Ensenada, después se han extendido a otros lugares, tanto al Sur como al Norte de Ensenada, en lo general arrendando ranchos.

Naturalmente no han inmigrado únicamente agricultores y mineros, sino también vinieron comerciantes, artesanos, etc., que se establecieron en las poblaciones más grandes. Además, hay cierta cantidad de pasantes que sólo se quedan durante tiempo determinado de mayor o menor duración; estos pasantes van casi exclusivamente a Ensenada y Tijuana.

En la zona estudiada por nosotros existe solamente una ciudad: Ensenada de Todos Santos, con unos 2,500 habitantes, dos pueblos un poco menos importantes: el Rosario y Tijuana; además hay cierto número de pueblos pequeños como Real del Castillo, Santo Tomás, San Telmo, San Quintín, Santa Catarina y Calamahí. En varios puntos existen pequeñas congregaciones o rancherías como Guadalupe, al Norte de Ensenada; San Vicente (ex-misión), Santo Domingo (ex-misión), San Borjas. Además, existen algunos lugares que no pertenecen a ninguna de las categorías mencionadas; las designamos como campos mineros y a ellos pertenecen: Laguna de Chapala, León Grande, Punta Prieta y Campo Alemán. Todo el resto de los habitantes vive en ranchos aislados.

De las misiones de los jesuitas, franciscanos y dominicos, se han formado en parte pueblos o rancherías como El Rosario, Guadalupe, San Vicente, Santo Domingo y San Borjas; otras se han convertido en ranchos como San Miguel del Descanso, Misión Vieja (San Miguel) y San Fernando; este último ha decaído mucho, existiendo allí antes una ranchería.

Ocupación principal de los habitantes.

El censo del año de 1900 da ciertamente una estadística de la profesión principal de los habitantes, pero estas cifras seguramente ya no están de acuerdo con las condiciones actuales, especialmente a causa de la fluctuación de la población, de la cual hemos hablado arriba. La consecuencia es que aquí no podemos dar cifras exactas sino únicamente algunos datos generales.

Dejando aparte Tijuana y Ensenada, debemos decir que la mayoría de los habitantes en nuestra zona se ocupa en la agricultura y ganadería; una minoría se dedica a los trabajos mineros; otra, como los habitantes de la región de Santa Catarina, trabaja principalmente en las canteras. En los pequeños pueblos y rancherías existe npequeñas tiendas, cuyos dueños en lo general no se ocupan únicamente de ellas sino son al mismo tiempo agricultores o ganaderos. Los agricultores trabajan sus terrenos en lo general sin la ayuda de peones o con la de unos cuantos; la causa de estas condiciones es la falta de habitantes, y lo que está en conexión íntima con ésta, los jornales sumamente altos en comparación a los que se pagan en la mayor parte de la República. La situación de los granaderos es muy semejante.

Comercio, en una escala un poco más grande existe únicamente en Ensenada y Tijuana; el comercio de este último lugar se limita casi exclusivamente a la venta de curiosidades a los touristas que vienen diariamente de los Estados Unidos. El comercio de Ensenada es de mayor importancia porque provee casi a todo el Norte de la Península. Además, existe en Ensenada un núcleo de establecimientos industriales pero el número de artesanos es bastante limitado. En Tijuana y Ensenada existe un número bastante crecido de cantinas y algunos hoteles que deben su existencia principalmente al movimiento de pasajeros bastante fuerte en ambos lugares.

En Ensenada, como cabecera del Distrito y aduana marítima, y en Tijuana, como puerto de entrada, reside, naturalmente, cierto número de empleados federales teniendo los dos lugares una guarnición militar.

La salubridad es en lo general muy buena en toda la región que hemos visitado; no hemos oído hablar de epidemias, con la única excepción que en el Rosario murieron en enero y febrero varias personas aparentemente de meningitis.

La distribución de las propiedades.

Terrenos baldíos o nacionales no existen en la zona estudiada por nosotros, por haber sido cedidos para colonización o vendidos a dos Compañías, la Mexican Land and Colonization Company y la Lower California Development Company (originalmente la concesión de Flores-Hale); la primera de estas Compañías tien todo el terreno desde la frontera con los Estados Unidos hasta el paralelo 28°; la segunda el terreno en un ancho de 6 leguas desde la orilla del mar,

* H. H. Bancroft, History of California, vol. I, San Francisco 1884. p. 731.

comenzando en el paralelo 29° para el Sur. Una pequeña parte del terreno de estas dos Compañías ha sido vendida a particulares, otra parte se arrienda a rancheros y ganaderos; casi todo el resto no es económicamente productivo.

La explotación del suelo.

Hemos tratado de dar una idea general de la configuración del terreno, de su composición, de sus habitantes y de la manera como está distribuido entre éstos; ahora tenemos que demostrar cuáles son las riquezas contenidas en este terreno y de qué manera el hombre las ha explotado o las utilizará en lo futuro bajo las condiciones dadas por el carácter del país e indicadas en la primera parte de este trabajo.

Desde el punto de vista de la economía social, el suelo puede explotarse de dos maneras: primero, directa, y segundo, indirectamente. La explotación directa comprende la utilización inmediata de sus componentes como los metales, las piedras preciosas, piedras de construcción y de adorno, sales y aguas. La explotación indirecta se ocupa de la utilización del mundo orgánico que depende del suelo de una manera más o menos directa y abraza así las cuatro ocupaciones primitivas y más antiguas del hombre, es decir, la agricultura, la ganadería, la caza y la pesca.

Metales, minerales y rocas.

Metales explotables son en nuestra zona el oro, el cobre, el fierro y quizá también tungsteno yteluro.

Oro.

El oro se encuentra en dos diferentes clases de criaderos: en diques de cuarzo aurífero y en placeres. Diques de cuarzo aurífero no se encuentran en la parte septentrional de nuestra zona o por lo menos no han sido hallados hasta ahora. Hemos observado los primeros en la latitud de Ensenada, es decir, en el cañón de las Cruces y en los alrededores de Real del Castillo. Son vetas de cuarzo que cortan pizarras metamórficas; la mayoría de estas vetas no tienen una potencia muy grande, no hemos visto ninguna que pase de 50 cm. de ancho, aunque según los díceres de la gente existen varias de una potencia de algunos metros. No hemos estudiado las minas de Real del Castillo con detenimiento, porque en realidad ya estaban fuera de nuestra zona, pero según lo que pudimos observar, parece que en varias de las minas se han encontrado cuarzos con buena ley de oro, especialmente en las partes superiores; esto ha dado ocasión a empresas de alguna magnitud como en el Campo Jordán, en el cañón de las Cruces donde se ha instalado una maquinaria bastante costosa. Todas las minas están paradas en la actualidad; la causa parece ser principalmente que la ley de oro disminuye en los diques de cuarzo rápidamente hacia abajo; esto parece haber servido de motivo para que ninguna de aquellas minas haya llegado a una profundidad considerable.

Cerca de Real del Castillo se han encontrado también placeres de oro. Estos se componen de depósitos de acarreo, gran parte del cual proviene de los crestones de los cuarzos auríferos. Por la acción del agua la roca fué triturada y después depositada en capa delgada sobre pequeñas mesetas o en los cauces de los arroyos; una separación y concentración a causa del peso específico diferente de los componentes era la consecuencia natural de este fenómeno; así es que el oro y las rocas pesadas quedaron depositadas mientras el agua arrastraba las piedras de menor peso. Los placeres de Real del Castillo eran bastante ricos, pero formaron una capa muy delgada con excepción de los depósitos en los arroyos que tenían una potencia un poco mayor; en la actualidad estos placeres están prácticamente agotados, aunque se encuentren de vez en cuando, después de algún aguacero fuerte algunas pepitas de oro.

Desde el citado punto hacia el Sur no se encuentran en la zona de la costa otros criaderos de oro; éstos se hallan en el interior, fuera de nuestra zona. Solamente al Sur del paralelo 30° hemos tenido oportunidad de visitar algunos criaderos de cuarzo aurífero, pero todos éstos están más o menos apartados de la costa en el interior de la Península. La región aurífera más occidental de esta porción del Territorio, de León Grande, una de las pocas que trabajan en la actualidad. Se trabaja una veta de cuarzo que arma en diorita, su espesor es de 25 cm. En la profundidad el oro se encuentra en pirita que en la zona superior se descompone en limonita y oro libre. La profundidad más grande alcanzada es de unos 45 metros debajo de la superficie. La explotación se hace en un tiro inclinado y dos pequeños socavones, la extracción del metal se efectúa en carros sobre rieles en el tiro inclinado que son movidos por una máquina de gasolina. Parte del metal ha sido beneficiado en Punta Prieta situada al Sur de León Grande.

En Punta Prieta existe un pequeño molino de metal y varios tanques para cianuración. La mina cuyos metales se pensaba beneficiar en este punto, dista de allí unos 14 kilómetros y se llama Mina Colombia. Es una veta de cuarzo ancha que arma en pizarras. La veta es pobre y hasta ahora no costea beneficiar el metal.

Un poco más al Norte y hacia el interior de la Península, existe la pequeña mina de Chapala. La veta es un dique de cuarzo que arma en granito con inclusiones de diorita; su ancho varía entre 50 centímetros y 1 metro 50. El oro se encuentra en limonita. Los trabajos en la mina han llegado hasta una profundidad de unos 75 metros, de los cuales los primeros 50 muestran metal, mientras que en los últimos 25 metros no se ha encontrado oro.

Otra región durante cierto tiempo que fué célebre por sus ricos placeres y sus vetas de cuarzo aurífero existe en los alrededores de Calamahí y Campo Alemán. Las condiciones de estos lugares en tiempo de aquella bonanza fueron descritas detalladamente por la primera Comisión enviada a Baja California por la Secretaría de Fomento. (1)

Este informe es tan extenso y se ocupa tanto en los pormenores, que nosotros no necesitamos entrar aquí en detalles. Actualmente ya no se trabaja en ninguna mina de Calamahí, las grandes instalaciones de maquinaria han quedado abandonadas y los mineros han desaparecido. En el distrito de Campo Alemán se siguen haciendo trabajos de exploración en la mina de El Arco, mientras que las otras minas están paradas. En los placeres lavan algunas personas periódicamente un poco de oro, pero prácticamente parecen los placeres estar agotados. Según los datos que pudimos recoger en el lugar y que en parte nos fueron proporcionados por el Sr. Alberto Hartsch en Campo Alemán, las vetas de cuarzo aurífero de toda la región han sido bastante ricas en la superficie y en la zona superior, mientras que hacia abajo el cuarzo perdía rápidamente en ley de oro y generalmente la explotación ya no era costeable a una profundidad de unos 100 a 150 metros.

Cobre.

En muchas partes de la zona estudiada se encuentran criaderos de cobre, casi todos hoy en día sin importancia comercial. Entre Tijuana y Ensenada hemos visitado los criaderos de la mina de El Sueño (entre la Mesa Redonda y Tijuana, cerca del rancho de los Alisos), la de Santa Rosa y la de San Antonio. En la mina de El Sueño se han hecho trabajos de bastante importancia así como instalaciones de maquinaria moderna, el resultado ha sido casi nulo. Como en muchos otros casos vemos también aquí que carbonatos de cobre tiñen grandes partes de los cerros, aparentando la existencia de grandes vetas; pero en realidad encontramos únicamente fracturas en el granito rellenadas con un poco de mineral que parecen ser anchas solamente porque el granito del panino está teñido por carbonato de cobre.

En la mina de Santa Rosa, entre la Misión Vieja de San Miguel y el rancho de Santa Rosa, y en la de San Antonio, entre San Marcos y el Sauzal, las condiciones son muy semejantes a las de la citada mina de El Sueño y aun menos favorables.

Entre Ensenada y San Quintín existen varias minas de cobre, todas aban-

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(1) Eduardo Martínez Baca. Informe sobre los placeres auríferos de Calamahí. Joaquín Ramos. Informe relativo a los trabajos ejecutados por la Comisión exploradora de la Baja California el año de 1884.—An. d. Ministerio de Fomento de la Rep. Mex., t. VIII. México 1887. pá. 286-327.

donadas en la actualidad con excepción de una sola, la mina de Marguerite, que ha producido alguna cantidad de metal. Esta mina, más bien conocida bajo la denominación de mina de Ink (pellido del propietario), se encuentra al Sur del rancho de los Alisitos que queda en la parte inferior del valle de Santo Tomás. El metal se encuentra en una veta de cuarzo que tiene un ancho hasta de un metro. El mineral principal es chalcopyrita y pyrita. Los trabajos ejecutados son un tiro de 44 pies y un socavón corto. Se han sacado varias toneladas de metal en parte bastante bueno.

Varias pequeñas minas se encuentran armando en el pórfido del cañón de San Antonio del Mar. Un grupo de éstas está al Noreste de la angostura del cañón. Los trabajos ejecutados en estas minas son de poca importancia; las vetas son poco considerables y parecen pasar a poca profundidad en vetas de espato calizo. El metal de las vetas es chalcopyrita, pyrita, cupryta y cobre nativo. Todas estas minas están actualmente abandonadas. Otro grupo de criaderos de cobre se halla cerca de la salida del cañón; éstas son todavía menos importantes que las citadas y contienen principalmente carbonatos de cobre, además de un poco de chalcopyrita.

Pequeños criaderos de cobre sin valor comercial se hallan en los terrenos del rancho de San Isidro, al Sur del arroyo de San Vicente. Estas minas son conocidas bajo el nombre de San Mateo. Contienen casi exclusivamente carbonatos de cobre en poca cantidad, la veta arma en granodiorita y es muy delgada. Cerca de estas minas, pero ya en el pie de los cerros en el valle del arroyo de San Vicente, existen los restos de una pequeña fundición clandestina donde se fundían metales de cobre, que según los datos que pudimos recoger, no provenían de la mina de San Mateo sino de una mina Delfina en los alrededores de la ex-misión de San Vicente. Encontramos en la fundición todavía una pequeña cantidad de mate.

Entre San Quintín y la laguna de Chapala, existen numerosos criaderos de cobre, casi todos sin importancia alguna. Las minas de cobre que se han trabajado durante algún tiempo y que parecen tener cierto valor, son las de San Fernando y de Sauzalito, que no fueron visitadas por nosotros sino por las otras comisiones, por estar en la zona estudiada por aquellas. Nosotros hemos visto gran número de pequeñas vetas sin valor comercial en nuestro camino. Una de éstas se encuentra en la cuesta del Aguajito, entre el Rosario y San Fernando; la veta arma en pórfido, es de poco espesor y contiene principalmente carbonatos de cobre. Otras varias vetas hemos visto en los alrededores de Santa Catarina armando en granito, éstas tampoco no son de importancia alguna. Contienen principalmente carbonatos y pocos sulfuros de cobre. Pequeñas vetas de cobre son muy frecuentes en los alrededores del rancho de Santa María, armando en parte en pórfido y en parte en granito. Ninguna de estas vetas tiene algún valor, aunque la mayor parte ha sido denunciada.

Resumiendo, podemos decir que hasta las mejores minas de cobre en nuestra zona han podido explotarse solamente mientras que sostenían un precio alto el cobre; es cierto que casi todas las vetas pequeñas de cobre han sido denunciadas a su tiempo y que en muchos lugares se ha tratado de explotarlas, pero en todas se han parado los trabajos después de que los emprendedores vieron que la explotación no costeaba.

Fierro.

El único metal de nuestra zona en cuya explotación se podrá pensar y que tendrá más tarde importancia económica es el fierro. El fierro se encuentra en numerosos lugares de nuestra zona, pero sólo en un lugar hemos observado criaderos cuya explotación sería posible. Una parte de estos importantes depósitos de fierro se halla cerca de la confluencia de los arroyos de Guadalupe y de San Isidro o San Vicente a unos 4 kilómetros de la ex-misión de San Vicente. Estos depósitos llevan diferentes nombres, como Marte, Colossus, Monitor, Vesubius, Hércules, Vulcán, etc. Hemos visitado otro criadero de importancia que se encuentra en la costa del mar al Norte del rancho de San Isidro del Mar. A este último depósito se le ha dado el nombre de Tepuztete. Todos los criaderos mencionados aquí son del mismo origen, es decir, depósitos de manantiales termales. Estas aguas han depositado su material en grietas de curso más o menos irregular y de diferente anchura. Este material no fué únicamente fierro sino que junto con éste se encuentra siempre sílice tanto amorfo (semiópalo) como en forma de arenas cuarcíticas (semejante a la variedad geyserita), conchoidal o en lechos delgados, también en forma de cuarzo y hasta en cristales. En algunos lugares se ha depositado principalmente fierro, en otros esencialmente sílice y en otros los dos minerales mezclados. Las fracturas rellenas de fierro y sílice atraviesan las rocas más antiguas como granito, diorita, pórfido, etc. Su potencia varía entre pocos centímetros y más de 10 m. El mineral de fierro consiste principalmente en hematita; en la superficie se encuentra en menor cantidad magnetita y relativamente poca limonita. Los depósitos más importantes que vimos en la confluencia de los arroyos de Guadalupe y San Isidro son el Colossus, el Hércules y el Vulcán. El propietario de estos depósitos puso a nuestra disposición unos análisis del metal ejecutados en Chicago por Dickman & McKenzie.

En la muestra número 3 de Colossus fué encontrado 0.50 por ciento de cobre; en todas las muestras se hallaron algunos por cientos de humedad, muy poco manganeso, magnesia, cal, aluminio y azufre.

Depósito		Hierro	Fosfatos	Sílice
Hércules	1	60.50 %	0.260 %	6 66 %
"	2	62 50 "	0.254 "	3 80 "
"	3	60 50 "	0.238 "	0.168 "
"	4	65.25 "	0.107 "	2.38 "
"	5	61.05 "	0.132 "	11.94 "
"	6	63.20 "	0-132 "	6.47 "
"	7	60.45 "	0.203 "	7.61 "
"	8	61.25 "	0.189 "	5.16 "
Colossus	1	59 65 "	0.165 "	11.28 "
"	2	56.65 "	0.173 "	13 89 "
"	3	63.25 "	0.242 "	3.16 "
Vulcán	1	62.35 "	0.094 "	6.13 "
Monitor	1	62.95 "	0,111 "	5.10 "

Los análisis anteriores dejan reconocer que los depósitos de fierro de la confluencia de los arroyos de Guadalupe y San Isidro tienen un contenido medio de 61.37 por ciento de fierro.

Los depósitos del Tepuztete están a bastante distancia de los mencionados en la costa del Pacífico al Norte del rancho de San Isidro del Mar. Allí existen diferentes depósitos, en algunos de ellos se han ejecutado pequeños trabajos de exploración que facilitan un estudio más exacto. En general se puede decir que el techo está formado por una capa de sílice de un espesor de 2 metros. Debajo de éste yace una capa de hematita de un espesor entre 2 y 3 metros. El bajo está formado por una diorita muy alterada. El fierro se compone principalmente de hematita, poca magnetita y limonita; en partes el fierro contiene bastante manganeso, lo que le da un valor especial. El depósito de Tepuztete no tiene tanto el carácter de una veta como el de una capa con un echado de 22° S.W. Es de mucho interés el que en los respaldos de los depósitos del Tepuztete haya tenido lugar una formación posterior de minerales de grossularita, epidota y bustamita.

A causa de las condiciones naturales de los depósitos y a consecuencia de la falta de trabajos de exploración, aparte de los del Tepuztete, un cálculo de la cantidad de fierro existente en los depósitos es sumamente difícil. Los crestones han sido parcialmente destruídos por la influencia de la atmósfera y de la erosión; a consecuencia de esto grandes y pequeñas piezas de fierro han rodado sobre las pendientes de los cerros cubriendo la superficie y creando así la impresión de que los depósitos sean mucho más enormes de lo que son en la realidad. Un cálculo prudente nos hace presumir que los depósitos de fierro "in situ" contienen por lo menos unos.... 5.000,000 toneladas de metal, probablemente mucho más. Así pues, no hay que olvidar la enorme cantidad de de-

tritus de mineral de fierro que se encuentra en las laderas de los cerros; seguramente se trata de muchos miles de toneladas de muy buen mineral propio para ser fundido.

Sobre estos depósitos de fierro, especialmente sobre su modo de formación fué publicada una nota por el Sr. Dr. E. Wittich, en el Acta de la Asamblea General de Invierno, verificada el 19 de enero de 1912, de la Sociedad Geológica Mexicana, p. VI-VIII.

Respecto a la explotación de los depósitos de fierro, debemos decir que un grave inconveniente para ella presenta, y es la falta absoluta de combustible. Para la exportación del mineral bruto es favorable la pequeña distancia entre los depósitos y la costa, que será apenas de unos 10 kilómetros para las vetas en la confluencia de los arroyos de San Isidro y de Guadalupe, y de unos 500 metros para el depósito de Tepuztete. Cierto obstáculo para la explotación de los depósitos nos parece presentar la intensiva subdivisión de las propiedades mineras en esta parte; ésta la indica el enorme número de mojoneras que se observa en el terreno; hemos podido contar varios centenares en pocos kilómetros cuadrados.

En comparación con los depósitos descritos aquí, todos los otros que hemos visto en nuestro viaje, son de poca monta, aunque a veces tengan nombres como Iron Mountain, Iron Shield, Iron Wonder, Iron Giant, etc. En parte se trata de vetas angostas cuyos crestones han sido destruídos y cuyo material cubre gran parte de la ladera del cerro.

Según datos que hemos podido obtener durante nuestro viaje, existen cerca de nuestra zona, aunque fuera de ella, en algunos lugares, criaderos de "teluro" (Valladares) y de "tungsteno" (Sierra de los Mártires); es posible que estos hallazgos lleguen más tarde a tener cierta importancia, aunque hasta ahora se trate solamente de criaderos pequeños y poco numerosos.

Salinas.

Entre las riquezas del suelo de la zona estudiada por nosotros, las salinas, no obstante existir en número pequeño, ocupan un lugar de cierta importancia.

En capítulo por separado nos ocuparemos de ellas en el póximo número de The Mexican Mining Journal.

Purificación de las Aguas.

(Continuación).

El bromo y el yodo también han sido usados, pero sus resultados no han sido prácticos.

El bisulfito de soda aconsejado al ejército ingl½s, neutralizando en seguida la acidez resultante del ácido sulfúrico puesto en libertad por medio del bicarbonato de soda, queda como un medio de urgencia únicamente.

Par terminar, citaremos el procedimiento de Almen que consiste en agregar seis gotas de tintura de percloruro de hierro por litro de agua, en seguida tres centímetros cúbicos de una solución saturada de bicarbonato de soda. La materia orgánica del agua disminuye en un sesenta por ciento apenas. Es e ltratamiento que menos buenos resultados da, pero es tan sencillo que siempre conviene tenerlo en cuenta para un caso de necesidad.

"La ozonización" en práctica en algunas partes da buenos resultados, pero necesita alguna instalación complicada y costosa.

"Los aryos ultravioletas" han sido utilizados con admirables resultados, dan una agua stéril, con gran rendimiento y por medio de una instalación poco costosa, pues sólo se utilizan los que desprende una lámpara eléctrica de mercurio; hay dos sistemas: uno que entrega el agua caliente y otro que no eleva la temperatura durante la esterilización; es uno de los procedimientos del porvenir.

Hulla Artificial.

El Dr. Bergius, de Hanover, ha leído en la reunión anual de la Asociación de Químicos Alemanes celebrada en Freiberg, una Memoria dando cuenta de sus experimentos científicos encaminados a la obtención de carbón de piedra. En un aparato construido especialmente, ha calentado celulosa o turba, con agua, a la temperatura de 340°, bajo la presión de más de 100 atmósferas. Una y otra substancias se han transformado en un producto que parece idéntico a la hulla, por sus caracteres físicos y químicos.

A la temperatura de 310 grados, el procedimiento requirió sesenta horas; a los 340° la transformación se hizo en ocho horas solamente. La velocidad de la reacción se duplica por cada aumento de 10° en la temperatura. Sobre esta base,el Dr. Bergius calcula que el lapso de tiempo necesario para la formación del carbón de piedra natural a la tempeartura de la corteza terrestre, puede calcularse en ocho millones de años, cifra que concuerda, aproximadamente, con los datos establecidos por la Geología.

La operación de cambiar las grandes y pesadas bandas de transmisión, de acuerdo con lo que dice nuestro colega Power, es sencillísima y se ejecuta del modo siguiente: el rollo de la correa nueva se coloca sobre la vieja y se le asegura una de sus extremidades con remaches o de cualquier otro modo. Luego se hará que la máquina marche lentamente hasta que se aproximen las dos extremidades de la misma correa, fijando sobre la correa vieja la otra extremidad que aun quedaba por asegurarse; entonces se procede a su empalme y, acabado esto, se cortará la correa vieja. Muy a menudo resulta difícil apretar las correas, pero con este método se consigue que sean tan tersas como las viejas. Hay que advertir que las extremidades de la correa deben fijarse a cierta distancia que permita poder hacer el empalme sin dificultad alguna.

Nueva Piedra Artificial.

Recientemente se ha tomado patente por una composición que puede moldearse para formar bloques de piedra artificial, y consta de 60 partes de tierra o escoria molida, 10 de carbón de piedra, 16 de magnesita calcinada y 10 de cloruro de magnesio, con o sin la adición de una pequeña cantidad de arena, magnesia calcinada, aceite y materia colorante.

El cloruro se disuelve en agua, se añaden la magnesita y la magnesia y la mezcla se agita con las escorias y todo lo demás durante treinta minutos, luego se moldea la masa y queda el bloque hecho.

En determinados lugares del mundo, y debido a ciertas condiciones naturales, la madera se convierte en piedra, y este material es usado para la construcción de edificios o para obras decorativas. No se sabe que por medios naturales la madera pueda ser convertida en metal, pero existen medios artificiales para lograr este fin.

La primera operación que exige este proceso transformativo es la inmersión de la madera en un baño de álcali cáustico, a una temperatura de 190 grados Fhr., en el cual se la deja permanecer por dos o tres horas, según su porosidad.

Después de esto, se la sumerge en hidro-sulfito de calcio, durante veinticuatro horas, y al cabo de ellas se le agrega a tal baño una solución concentrada de azufre.

Después que ha permanecido en esta mezcla por veinticinco horas, se la saca tato de plomo a 100 grados Fhr. Se la tiene allí durante cincuenta horas, sosteniendo la temperatura a 170 grados. Tal operación completa el proceso.

Una vez que la madera sometida a él se ha secado perfectamente, se la puede pulir, lo cual le presta la misma apariencia de un espejo metálico. Es inatacable por la humedad, no se pudre ni es susceptible de corrosión, y dura largo tiempo.

Su único inconveniente es el de no ofrecer la misma dureza del metal.

Es cosa frecuente encontrar restos de los árboles que crecieran en las selvas primitivas, en un tan completo estado de petrificación, que ofrecen la misma solidez de las rocas más duras. Indica esto que la naturaleza posee medios propios para hacer de la madera blanda una substancia que rivaliza por su dureza con los minerales de mayor resistencia.

*La Planta de Huaraucaca, en Cerro de Pasco, Perú, S. A.**

La planta de Huaraucaca, está situada en la extensa planicie del mismo nombre, al SO del Cerro de Pasco, a orillas del río San Juan y a 3 km. de la fundición de Tinyahuarco.

El mineral que se somete a la concentración, viene de la mina de "Colquijirca," valioso yacimiento situado a 3 km. de la línea del ferrocarril Cerro de Pasco-Smelter, habiéndose destacado un ramal que parte cerca de este último lugar y llega bajo las grandes tolvas de la cancha. Este mineral tiene composición algo compleja, pues contiene sulfuros, como el panabás, chalcopirita, y pirita con ganga cuarzosa y especies oxidadas, bajo la forma de pacos; también contiene blenda y galena argentíferas, cobres grises argentíferos, mezclados con arseniuros y antimoniuros, etc.

La usina trabaja por plata y cobre. También se concentran los minerales bismutíferos de la mina de "San Gregorio." Los minerales de "Colquijirca," son muy apropiados para la concentración, por la fuerte proporción de ganga, 48 a 68 por ciento de estéril que contiene.

Vamos a tomar el mineral en la mina de "Colquijirca" y a estudiar el camino que sigue en su tratamiento.

El mineral a toda broza, sacado de las minas, es depositado en las grandes tolvas ya citadas, y de allí conducido en carros del ferrocarril, a la estación de Fernandini, situada frente a Huaraucaca y como a 4 km. de distancia. Diariamente a las 9h. 50 a. m., llega un tren compuesto de seis carros trayendo un total de 198,000 kilos y aun más siendo esta cifra variable, pues depende de la intensidad de los trabajos de "Colquijirca," pero tiene un límite mínimo que es de 100,000 kilos diarios. Estos carros son de vaciado automático, pero sin embargo, la descarga es sumamente laboriosa, debido a que el mineral generalmente viene húmedo, y por efecto de las sacudidas y vibraciones del carro, se va prensando al fondo, dando como consecuencia la adherencia del mineral (en trozos y menudo) a las paredes algo inclinadas del carro siendo necesario para descargarlo hacer uso de palas y barretas. Estos carros se descargan en un gran bin, compuesto de doce depósitos separados, de los cuales ocho son para minerales y cuatro para carbón menudo, que también compran de "Goyllarisquizga" y "Quishuarcancha," para quemarlo y hacerlo coke para la fundición. Cada uno de estos depósitos tienen capacidad para 20 toneladas, provistos para regularizar el vaciado, de compuertas con cremallera.

De estos depósitos son bajados en carros, el mineral y el carbón, por un funicular de 400 metros de rieles (plano auto-motor), con inclinación de 38°. Cada viaje se hace con un par de carros llenos que bajan para hacer subir a otro par de carros vacíos. La capacidad de cada carro es de 2½ toneladas. Hace cuatro viajes por hora durante 12 horas, pues en las noches no funciona.

Los dos carros de mineral llegan a la parte alta de la planta, a una especie de "cancha;" allí son volcados automáticamente para vaciarlos. Como la línea está en la parte media elevada, el mineral cae a ambos lados Allí se hace el escogido siendo los trozos grandes y ricos quebrados y reducidos a tamaños más o menos pequeños para en seguida, ser tamizados en un tamiz del No. 10. Las partes gruesas son conducidas a la fundición. Los menudos que atraviesan la zaranda, constituyen la materia prima que se somete a la concentración. Este mineral menudo es elevado por carretillas al nivel de las antiguas chancadoras, que hoy no existen. La planta está dispuesta en plano inclinado. Una vez en el nivel respectivo, el menudo es conducido o bien directamente a un trasportador de gusano o bien al alimentador Tulloch de la batería de bocartes. Esto depende naturalmente del tamaño de los granos de la parte rica del mineral.

Cuando pasa directamente por el alimentador de gusano, llega a una especie de cajón rectangular, donde es diluido por un chorro de agua que viene a presión y una vez formada la pulpa desleída, se dirige por una cañería de fierro a los jigs. Otras veces pasa por la batería de bocartes, de los que existen dos de cinco pilones cada uno.

Cada pilón pesa 850 libras, con polea matriz de madera; tiene guías seccionales de fierro y el mortero es de simple descarga perfeccionado. El armazón es de madera dura y las levas son de ajuste automático sistema Blanton, de bastante economía, duración y resistencia, verificándose la molienda en húmedo saliendo la pulpa por el tamiz del mortero y por un tubo llega al cajón, de donde por otro, pasa a los jigs.

A veces la alimentación en bocartes y en el trasportador, es simultánea.

Existen dos juegos de jigs reunidos en serie, formando un solo macizo con dos jigs de dos compartimentos cada uno, que a primera vista, parece uno de cuatro compartimentos. El mineral desleído llega al canal repartidor que lo distribuye proporcionalmente a ambos jigs. Estos jigs son de movimiento excéntrico ajustable, de 2,5"; teniendo forros de acero en los compartimentos del émbolo, siendo los cuatro tamices de diferentes números que dan cuatro clases de productos concentrados. Estos dos jigs dan tres productos: 1° concentrados que se vacían, mediante las llaves que para el efecto tienen; 2° producto grueso que pasa a los dos molinos Huntington; 3° lamas o schlamms que también van a los Huntington. De cada juego de jigs sale un canal que conduce el mineral grueso a un molino Huntington, donde después de experimentar una molienda, sale a través del tamiz, se reune con las lamas que vienen del reboce de los jigs y reunidos los dos, marchan por un canal al gran clasificador o cajas asentadoras. El molino tiene seis pies más o menos de diámetro; da 58 vueltas por minuto; la fuerza requerida es de 10 HP y pesa más de 10 toneladas; el movimiento lo recibe por la parte inferior, por un engranaje a 90°.

La caja puntiaguda tiene cuatro compartimentos y sirve para clasificar los productos del molino de la manera siguiente: el producto del compartimento núm. 1, es decir, lo más grueso, se dirige a dos mesas "Frue Vanner;" el del núm. 2 o sea menos grueso, se dirige a una mesa "Ferraris" grande: el del núm. 3 o sea menos grueso que los dos anteriores, se dirigen a dos mesas "Overstrom." Como estas cajas son cuneiformes, la descarga de la pulpa asentada, se hace por medio de sifón. ,

Las lamas del núm. 4, se dirigen directamente a una bomba espiral de arena, que la lleva al Spitz-kasten, situado al nivel del molino Huntington.

Veamos ahora las mesas; existen 3 "Ferraris" (dos grandes y una chica), 2 "Frue-vanner;" en total ocho mesas. Sin entrar en la descripción de ninguna de ellas, por ser bastante conocidas, y no tener características variables, sino en la cantidad y presión del agua que las alimentan, voy a seguir la marcha del mineral.

Las dos Frue-vanners dan dos productos: concentrados y relaves. Los relaves van, por medio de un inyector, a una caja asentadora en dos compartimentos; el producto del primero pasa por una manguera, por medio de otro inyector, a la Ferraris chica y el del segundo, o sean los lamas, van a un depósito general.

La Ferraris chica, da también dos productos: concentrados y lamas y relaves que van al depósito general. Las dos Overstrom de la izquierda, dan también dos productos: concentrados y relaves que van al depósito de la bomba espiral de arena, y junto con los lamas del núm. 4, son llevados al Spitz-kasten, por medio de la bomba citada.

El gran Spitz-kasten, se compone de tres compartimentos. La pulpa del mineral llega al compartimento núm. 1, que está situado a nivel más alto y que a su vez, se subdivide en tres pequeños compartimentos; el mineral llega por la parte superior al primer sub-compartimento, pasa por reboce al segundo y de aquí al tercero; de la parte inferior del segundo sub-compartimento, sale un tubo que conduce los gruesos al compartimento núm. 1 de la caja asentadora. Del

* Boletin de Minas Ind. y Construcciones.

tercer subcompartimento del primer compartimento del Spitzs-kasten, pasa al segundo gran compartimento y de aquí pasa por la parte inferior, a otro gran compartimento central rectangular y de éste las lamas pasan por reboce, al último compartimento más pequeño; de la parte inferior de éste último, sale una cañería que lleva estos productos a 2 cajas situadas a nivel un poco inferior al Spitz-kasten, pero superior a las mesas. Entran por la parte superior, se asientan un poco y el resto sale por la parte inferior y van a una mesa "Overstrom" que da dos productos: concentrados y relaves que alimentan una bomba que los eleva a otro cajón de un solo compartimento. De la parte inferior de este cajón, sale el producto grueso aún, por un tubo y va a una última mesa "Ferraris" grande, que da dos productos: concentrados y relaves que ya botan al río.

De la parte media de los cajones anteriores y de este último, salen los productos medios y lamas que van a un depósito, de donde una bomba grande los eleva a los tanques situados al nivel de los jigs. También llegan a las cochas o pequeños pozos o lagunas, las lamas que no se concentran en las mesas, donde se encuentran, y después son descargadas por la compuerta respectiva y llevados en carros, al depósito general para su desecación al aire libre, donde hay un verdadero hacinamiento de lamas, más de un mil toneladas, listas para entrar a la cianuración.

La ley de estas lamas es de 8.80 marcos de plata por cajón (6,000 lbs.) y 4 por ciento de cobre.

Los concentrados de los dos jigs y ocho mesas se recogen y se transportan en carretillas a la fundición.

Como se habrá notado, los únicos relaves que se botan al río, son los de la "Ferraris" grande; los demás van a las cochas a asentarse. Las cochas son grandes depósitos especies de lagunas (15'×9'×15'). Como se ve, pues, en esta concentración, "casi" nada se pierde, todo se aprovecha.

Entran diariamente a la concentración treinta toneladas de mineral. La relación de concentración, es de 5 a 1.

Los minerales que más se concentran, son los cobres grises argentíferos de "Colquijirca."

Las chancadoras "Dodge" y molino de bolas, que antes funcionaban, están hoy paralizados y abandonados.

El mineral para la concentración, viene ya seleccionado a toda broza.

Se obtienen seis toneladas de productos repartidos así: 40 por ciento de concentrados, 30 por ciento de lamas y 30 por ciento de relaves.

Como hemos dicho, los minerales entran a la concentración con leyes sumamente variables de riqueza, que en término medio, es de 2 a 17 por ciento de cobre y 3 a 30 marcos de plata por cajón, y salen contardos con leyes dobles, según puede verse por el cuadro estadístico siguientet, proporcionado por la oficina de enseyaes.

	Ley en plata de mineral concentrado.
Vanners Nº 1 y 2	28.20 mc. por caj.
Overstrom	27.60 ,,
Ferraris grande	19.00 ,,
Ferraris chica	10.60 ,,
Grueso	11.60 ,,
Menudos	23.20 ,,
Relaves Ferraris grande	3.60 ,,
Id. chico	5.60 ,,
Lamas	8.80 ,,

La fuerza motriz para el movimiento de los diferentes aparatos ya vistos, es proporcionada por tres turbinas hidráulicas, de doble descarga, del tipo Leffel, de eje horizontal y de 100 caballos de fuerza, movidas por el agua del río "San Juan," que es conducida desde la toma en "Río Blanco," por un largo canal. La altura de la caída es más o menos de 80 metros.

También para las épocas de sequía, existen dos motores eléctricos: uno grande 500 voltíos y otro chico de 110, tipo Siemens, de corriente continua. Las turbinas y los motores se auxilian mutuamente; se puede decir que el rol de los motores eléctricos es compensar la pérdida del agua de las turbinas que se traduce en menor número de revoluciones por minuto y por consiguiente, hacer variar constantemente el movimiento, y para conservar esa constancia equilibrada es para lo que se usan los motores.

Cuando por efecto de los temporales, se queman los motores eléctricos, quedan funcionando las turbinas.

Sección de Fundición.

El mineral tiene muy poco azufre y sílice; en cambio, tiene mucho fierro. Sucede lo contrario de "Tinyahuarco," donde los minareles tienen mucho azufre y sílice y falta fierro.

La fundición trabaja por plata y cobre.

La instalación consta de los niveles siguientes:

Primer nivel: de la cancha, balanza, tec.

Segundo nivel: de los antiguos hornos Brown, Turret, etc.

Tercer nivel: Bin, cancha para hacer las mezclas, máquinas de hacer briquetas, ventiladores, tragante de los dos water-jacket, etc.

Cuarto nivel: de los dos water-jacket, etc.

Por el primer nivel circulan los carros cargados de minerales. Tenemos pues, el mineral en este nivel, es decir, en la cancha y sigamos su marcha hasta ponerla ya beneficiado, en los carros para su exportación.

Como ya hemos tenido ocasión de decirlo, el mineral en trozos de la cancha, es trasportado por carros al Bin, de donde se saca y se lleva a la fundición. Los carros son del tipo corriente, de volteo automático, capacidad de dos toneladas, de forma rectangular, de dimensión 62" ×38". La capacidad del Bin, es de 100 toneladas.

Actualmente el mineral no experimenta tostado ninguno, puesto que la proporción de azufre que tiene, es muy pequeña: apenas alcanza para las exigencias de la fusión; ésta se realiza pues, en crudo.

Antes de ahora, se tenía para el tostado de los minerales sulfurados de cobre del Cerro de Pasco, cuando se disponía de los minerales de "La Docena," etc., una batería de seis "Kilns," un gran horno "Brown" de 160'×16' y dos hornos "Turret" con rastrillos mecánicos; pero hoy están abandonados, como ya llevo dicho, porque los minerales son pobres en azufre. De los minerales tostados, se fabrican briquetas en dos máquinas del tipo "Boyd Brick Press" para ir a la fundición. Hoy se procede del siguiente modo: antes de someter el mineral a la máquina de hacer briquetas, se hace previamente una mezcla de los minerales concentrados en los jigs y mesas y del menudo rico, en las proporciones siguientes:

Composición de la mezcla para el ladrillo.

Proporciones	Volnms	LEY Plata mcs. p. caj.	LEY Cobre
Concentrados	300	32.00	0.75 %
Humos y polvos	75	18.40	0.80 ,,
Bronce [pirita] [Sio2 15.50 %]	60	2.00	5.25 ,,
Mcobrinaeral de e [Sio2 53 %]	60	0.80	9.75 ,,

Tan luego como se efectúa la mezcla, por medio de palas, se lleva en carretillas a la máquina de hacer ladrillos. Hay dos de estas máquinas, que consisten en un molino chileno de una sola rueda de fierro, rellenada de piedras; la taza tiene a ambos lados moldes cilíndricos y

por debajo, corre constantemente una banda de cuero sin fin que saca las briquetas; éstas son cilíndricas, de 3½" de altura y 4½" de diámetro y pesan cerca de cuato kilos. Estas briquetas son trasportadas por muchachos a un depósito frente al tragante del water-jacket, en carretillas de 16 ladrillos cilíndricos cada una.

Ya tenemos el mineral bajo dos formas: 1° mineral crudo en trozos; y 2° mineral crudo en briquetas; veamos ahora como se preparan las cargas del lecho de fusión.

Los fundentes que se usan son de fierro, manganeso, la sílice y la cal. Existen actualmente trabajando, dos water-jacket, uno pequeño instalado en el año '899 de 75 toneladas de capacidad, pudiendo llegar, forzando la carga, a 100 toneladas diarias; sus características son: sección rectangular; dimensión de 4'×2' muy cerca de las toberas, en el interior; en el tragante, estas dimensiones aumentan. La altura del suelo al tablero de carga es de 5 m.; tiene 12 toberas: seis a cada lado mayor; tiene el horno 12 camisas de agua, 4 a los lados mayores y 2 a los lados menores; 2 tubos grandes de aire o porta-vientos principales, de 9" de diámetro; una abertura de escoria y otra de mata colocada más abajo y un carro separador de escorias, de regular tamaño. El agua que circula por la camisa de agua, viene del río "San Juan," por un canal construido ad hoc, de más de dos kilómetros de longitud por un metro de ancho, provisto de sus compuertas de entrada y reparto de agua. La compuerta de distribución se halla en la parte más alta de la usina. Altura de la caída, 50 m. La chimenea es de sección cuadrada, hecha de escorias y de 50 metros de altura.

El otro water-jacket es grande y fué instalado en 1908. Es del mismo tipo que el anterior, con capacidad para 150 toneladas; sus características son iguales al anterior.

El aire necesario es suministrado por tres ventiladores del tipo "Conners ville," con desplazamiento, cada uno, de 24 pies cúbicos de aire por revolución.

La presión del aire para el horno grande, es de 18 onzas de mercurio y para el chico de 12.

Las cargas son traídas en carretillas y pesadas en la balanza, estando constituídas tanto para el water-jacket No. 1 como para el No. 2, de la siguiente manera:

La escoria unas veces se granula por un chorro de agua fría a presión, y luego con un inyector en combinación con una bomba centrífuga se le expele al Río "San Juan." Otras veces se hacen ladrillos rectangulares para la construcción de muros, pavimentación de patios y corredores, para los estribos de los puentes, para chimeneas, para hacer las cochas, etc., etc.

La abertura de la mata se abre cada veinte minutos, para el vaciado en una vasija de la que luego se distribuye sobre una serie de 25 moldes pequeños,

Mineral de "Colquijirca"..	1500	libras
Briquetas de mineral..	2000	»
Mineral de fierro, manganeso y piedras de sílice..	80[illegible]	»
Piritas de fierro cupríferas.. ..	200	»
Caliza..	1200	»
Escoria sucia..	600	»
Mata pobre..	800	»
Coke..	700	»

bañados previamente con una lechada de cal, e instalados en el suelo, de donde después de enfriados, son sacados, valiéndose de ganchos y trituradas luego en una "Blake," para ser llenados en sacos de lona, de siete arrobas, y cargados para su exportación. Antiguamente, cuando se tostaba el mineral, se usaba como combustible la taquia, la hulla seca y las pizarras bituminosas. Hoy para la fundición se usa el coke nacional, que se obtiene mezclando carbón menudo de "Goyllarisquisga" y "Quishuarcancha" y coke alemán. La sección de la preparación del coke nacional, consta de una batería de ocho hornos acoplados en serie, formando un solo macizo. Entran diariamente ochenta toneladas de mezcla y y salen 50 toneladas de coke descargándose cada 48 horas.

La proporción de coke empleado, es de 16 por ciento.

Las matas brutas obtenidas, tienen una ley de 47 por ciento de cobre y 700 marcos de plata por cajón. La mata concentrada llega a 65 por ciento de cobre y 900 marcos de plata por cajón.

Las escorias salen con 0.5 por ciento de cobre y pequeñísima proporción de plata y tienen la composición siguiente:

No. 1 (horno grande):
SiO_2=41.25%; FeO=31.50%; CaO=19.65%
No. 2 [horno chico]:
SiO_2=38.50%; FeO=33.30%, Cao=19.05%

El número de operarios que trabajan, es algo más de 200, con jornal variable; así los que trabajan en los hornos y en la concentración, ganan S. 3 y 3 por 24 horas, los otros peones ganan S. 1.50 y los muchachos de S. 0.80 a S. 1.

La antigua sección de amalgamación, se encuentra hoy abandonada.

Seccion de Cianuración.

Los relaves que antes se trataban por amalgamación, una vez paralizada ésta, quedaron depositados y como se iban acumulando más y más cada día, hasta formar hoy un hacinamiento enorme, hizo pensar seriamente al Ingeniero A. Rizo Patrón, en la mejor manera de beneficiarlos y de aquí el origen de la cianuración que principió a ensayarse en pequeña escala, desde hace algún tiempo, continuando aun los ensayos.

También existe una sección de concentración para minerales de bismuto, que viene de las minas de "San Gregorio" situada a 10 km. de Huaraucaca. El mineral es conducido en llamas. Estos minerales contienen sulfuro de bismuto, y se presentan muy bien a la concentración por agua; tiene una ley de 0.5 a 2 por ciento de bismuto, que se eleva hasta el 20 por ciento por concentración, la que se realiza simplemente en cuatro tanques, colocados a diferentes niveles y las lamas bismutíferas pasan de un tanque a otro sucesivamente y se asientan. Los concentrados se exportan a Estados Unidos.

La planta cuenta con un magnífico laboratorio de ensayes, el cual no deja nada que desear.

Sección de electricidad.

Esta es completa y una de las mejores de su género, en el Centro del Perú. La central se halla en Río Blanco y cuenta con dos turbinas, tipo "Leffel" de 700 HP cada una, que mueve a dos dinamos del tipo "Siemens y Halske," de corriente alternada trifásica. Esta fuerza se emplea en la usina de "Huaraucaca," "Colquijirca," "Smelter" y Cerro de Pasco." La corriente trifásica de 10,000 voltíos que viene de "Río Blanco," es transformada en la planta de "Huaraucaca," en corriente continua, de 500 voltíos, que se emplea en la tracción eléctrica y alumbrado. La instalación o sub-estación de "Huaraucaca," tiene 4 rótaris, tipo "Siemens y Halske," con su pequeño motor de arranque, tablero de distribución completa y una instalación potente de pararayos.

Tratándose de oro precipitado por medio de ácidos, el proceso de torrefacción o tratamiento por el fuego, es necesario sólo cuando una cierta cantidad de zinc perdura en aquél. En todo caso tal proceso debe evitarse siempre que fuere posible: su empleo no determina aumento alguno en la pureza del oro. Cuando se han usado raspaduras de zinc como precipitante, la completa remoción de éste se obtiene fácilmente con la aplicación del ácido después de lo cual se filtra el producto y se le lava con agua caliente. Si se emplea zinc en polvo, después de que el ácido se aplique, quedará un considerable porcentaje de dicho metal: para desalojarlo conviene usar un método alternativo tal como la fundición con litargirio. Cuando el quijo tratado es de alta calidad, hay un sistema muy sencillo para efectuar su limpieza el cual consiste en cribar el precipitado, filtrarlo por presión y fundirlo directamente. Tal método se emplea también en el caso de los quijos de plata tratados por cianuración.

*La Electrización Natural y Artificial de la Atmósfera.**

La electricidad en la atmósfera.

Se ha afirmado durante mucho tiempo que las regiones superiores de la atmósfera se hallan electrizadas positivamente, mientras que las cercanías del suelo lo son negativamente. Tierra y atmósfera, en su conjunto, pueden ser comparadas a una inmensa botella de Leyden en la cual la tierra constituye la superficie interior y las zonas elevadas de la atmósfera la superficie exterior. Para los tiempos borrascosos o lluviosos, las condiciones por lo general se invierten y mientras la tierra recibe una carga positiva, la atmósfera, a una cierta altura, toma una carga negativa.

El mecanismo del fenómeno parece ser el siguiente: bajo la acción de la luz ultra-violeta, las hojas de los árboles y de las plantas emiten electricidad negativa; la electricidad negativa del suelo se escapa también por la cúspide de los árboles y por la extremidad superior del tronco de las plantas, donde la tensión adquiere un valor elevado, lo que determina en la atmósfera, a cierta altura, una capa de electricidad negativa. El viento desplaza esta capa, que se mezcla más o menos con la capa superior, cargada positivamente, provocando así las deflagraciones observadas en las tormentas acompañadas de truenos. El buen tiempo sería, en el fondo, la verdadera causa de la tormenta que le sucede.

Las hojas de árboles, por lo general terminadas en punta más o menos dentadas en sus bordes, parecen constituir los conductores especialmente adaptados a la emisión de electricidad. La descarga eléctrica, de la cual ellos son el asiento, debe ser necesariamente un fenómeno beneficioso para su desarrollo, lo que conduce a la conclusión de que tal vez sería ventajoso el intensificar artificialmente esta descarga para estimular el frotamiento o cualquier otra acción desconocida, que el paso de la corriente debe necesariamente provocar en su superficie o en su interior. La luz solar presenta a este efecto una eficiencia bien conocida.

Constitución de la atmósfera.

La mayoría de los meteorologistas están actualmente acordes en afirmar que la tierra está rodeada de una serie de capas concéntricas de naturaleza física y de constitución química distintas. Gracias al empleo de cometas y sobre todo de globos-sondas, se ha podido averiguar que, pasada cierta altura (7.000 a 11.000 metros), la temperatura deja de bajar y el termómetro marca invariablemente 20° bajo cero. Por otra parte, se ha observado que en las explosiones, el sonido no se siente a partir de una cierta zona, para ser de nuevo percibido en una zona más alejada que la precedente del centro de conmoción. Este hecho se atribuye a la reflexión del sonido sobre una capa superior de la atmósfera, formada casi exclusivamente de hidrógeno y situada a una altura de 75 km. aproximadamente.

El hecho de que algunas ondas hertzianas se propaguen a una distancia tan grande que no se les pueda sacar partido en su empleo para la telegrafía sin hilos, parece igualmente explicarse por la existencia, en las capas superiores de la atmósfera, de elementos distintos de los que existen en las vecindades de la tierra y que favorecen, gracias a la cual son sometidas, la transmisión de ondas eléctricas.

Se admite que inmediatamente alrededor de la tierra, se encuentra una zona de una altura de 10 km., en la cual las variaciones de temperatura son relativamente importantes en el sentido vertical y poco notables en sentido horizontal; esto es lo que se ha convenido en llamar la "tropósfera;" luego se encuentra una zona más extensa, alrededor de 60 km., en la cual la temperatura, variable durante el día, permanece uniforme en el sentido del diámetro: es la "estratósfera;" más lejos, comienza la "esfera del hidrógeno" que abarca alrededor de 130 km. y atravesando ésta llegamos a la "esfera del geo-coronio," que se halla formada por un elemento de constitución análoga al contenido en el anillo solar y que produce en el espectro la línea del coronio.

Causas de la electrización natural de la atmósfera.

El autor advierte que es preciso atribuir la electrización natural de la atmósfera no a causas locales, como la evaporación o condensación del agua, pero sí a una causa cósmica, que tenga su origen en el sol.

Los diferentes cuerpos, como se sabe, bajo la acción del calor, emiten electricidad; el sol no hace excepción. Las manchas que se observan en su superficie son formadas por masas de electrones amontanados, cuya erupción causa en nuestro globo, perturbaciones magnéticas bien caracterizadas.

El sol emite rayos y en el momento en que los rayos llegan a la tierra los electrones son, por decirlo así, aprisionados en el engranaje de las líneas de fuerza del magnetismo terrestre, desplazándose en espiral alrededor de estas líneas de fuerza, se sitúan en las regiones árticas y antárticas donde dan lugar al bien conocido fenómeno de las auroras boreales.

Los rayos a, cargados positivamente, siendo casi insensibles a la acción del magnetismo terrestre, se colocan en los trópicos donde la electrización es por consiguiente positiva. La atmósfera en las capas superiores, se halla ionizada por los rayos a y por los r, sobre todo por estos últimos que se hallan dotados de un poder de penetración, notable. La lluvia, en estas condiciones, tiene por efecto el traer hacia la superficie de la tierra la electricidad negativa, reteniendo la positiva, las capas superiores de la atmósfera.

Estando la atmósfera ionizada, a causa de la variación vertical de potencial, debe existir una corriente de arriba hacia abajo. La variación de potencial para buen tiempo es de un volt por centímetro; en cuanto a la corriente, no es más que de un micro-ampere por kilómetro cuadrado, debido a la débil conductibilidad del aire. Las capas superiores de la atmósfera, a causa de las bajas presiones reinantes a alturas elevadas, son necesariamente más conductoras y llegan a ser hasta excelentes conductores de la electricidad.

Electrización artificial de la atmósfera.

Se ha ensayado a menudo el producir, por medio de máquinas estáticas, la electrización artificial de la atmósfera. El inconveniente de este procedimiento es que la corriente obtenida no puede nunca tomar un valor apreciable; la razón estriba en que la intensidad de la corriente depende, en este caso, del desplazamiento, por medios mecánicos, de algunos elctrones, constituyendo una carga ordinaria de electricidad estática; no es de sorprenderse, en estas condiciones, que nos quedemos bien lejos, en lo que se refiere al tamaño de las corrientes producidas, de los resultados obtenidos con conductores metálicos en los cuales se dispone de verdaderas masas de electrones, para efectuar el transporte de electricidad.

Podríamos valernos de los procedimientos químicos y recurrir, por ejemplo, a poderosas baterías de pilas. La dificultad por estos medios, no reside ya en la obtención de la cantidad, pero sí en el potencial suficientemente elevado. Se puede decir otro tanto del dinamo cuyo aislamiento a las altas tensiones es difícil de asegurar.

Por estos motivos, el autor ha pensado recurrir al empleo de un transformador, utilizándolo en combinación con válvulas eléctricas de su invención. La energía se produce por medio de un dinamo a corriente continua, accionado por un motor de gasolina, produciendo 3 amperes 220 volts. La corriente desarrollada pasa en el primario de una bobina de inducción; en el secundario son insertadas las válvulas eléctricas cuyo papel consiste, por una parte, en enderezar la co-

* De la Institución of Electrical Engineers de Londros.

rriente y , por otra parte, en acumular la carga de electricidad a la manera de un verdadero depósito.

Otro procedimiento ensayado en Estados Unidos, utilizando las corrientes de alta frecuencia, obtenidas con un transformador y una bobina Tesla.

Aplicación de la electrización artificial a la producción de la lluvia y el buen tiempo.

Para obtener la lluvia, parece que es suficiente, según los resultados obtenidos, cargar la atmósfera de electricidad negativa. La inversa será lo indicado para la realización del buen tiempo; la dificultad consiste, evidentemente, en producir la elecricidad en cantidad suficiente y a una tensión suficientemente elevada. La cosa no es imposible y por lo tanto, merece ser experimentada.

No es, en manera alguna, temerario el pensar qu ese podría neutralizar y aún cambiar el magnetismo terrestre con el objeto de modificar la repartición de la electricidad atmosférica que, como hemos visto más arriba, está determinada por la acción de un par terrestre sobre los rayos emitidos por el sol. Una cintura metálica que envolviera el globo a una latitud bastante septentrional, para no ser de extensión exagerada, y recorrida por una corriente intensa, resolvería tal vez el problema. Suponiendo que la tierra sea en su mayor parte constituida por el fierro al estado nativo a una temperatura inferior a la temperatura crítica de este metal, la corriente requerida no pasaría del millón de amperes. Naturalmente, tendría un valor más elevado si las condiciones supuestas no se realizaran.

Una parte de la cintura en cuestión existe ya en estado embrionario constituyendo los rieles de los ferrocarriles, lo que adjudica a la realización de la idea expresada, un basamento que indica al estudioso que su ejecución no es en manera alguna quimérica.

La Edad del Petróleo y su Significación.

Verdaderamente sorprende el desarrollo que ha alcanzado el empleo del petróleo a últimas fechas para la generación de fuerza, cuyo desarrollo no cesa por razón de las grandísimas ventajas que en esa aplicación ofrece dicho combustible.

La circunstancia de que pueda usarse ventajosamente en los distintos tipos de motores de combustión interna así como en las calderas de vapor hacen que ese elemento sea de un valor inapreciable y su empleo continuará en aumento hasta que la producción comience a disminuir, peligro aun muy remoto, pues día a día son descubiertos en distintos puntos del universo nuevos criaderos.

Sin embargo, no obstante las mil aplicaciones que el petróleo tiene no es razonable suponer que éste vaya a substituir por completo al carbón de piedra. El petróleo encuentra su decidida aceptación para la generación de fuerza por razón de su alta potencia calorífica, por la ausencia de cenizas o residuos sólidos, su facilidad para manejarse y por consecuencia su relativa baratura y lo que es de mayor importancia, la grandísima ventaja que posee de poder ser quemado o hacerse explotar directamente dentro de los cilindros de combustión de los motores del tipo Diesel o de los de explosión.

En la actualidad vivimos en una nueva era o sea en la edad del petróleo. El vapor aun no ha desaparecido, pero decrece continuamente su aplicación, pues los motores de petróleo se ha generalizado tanto su uso y son tantos y tan importantes los cambios que se han operado en el mundo comercial con su advenimiento que el petróleo ha venido a ser de una influencia dominadora.

La utilidad del automóvil para fines comerciales y recreativos es indiscutible y la multiplicidad de su empleo no es sino consecuencia directa de la perfección de los motores de petróleo. Las máquinas de volar no eran sino sueños y afantasías hasta que fué conocido el empleo del petróleo como combustible haciendo con él fácil la construcción de una planta de fuerza motriz compacta, ligera y eficiente; requisitos que con los elementos antes conocidos no se conseguían.

El motor con quemador de petróleo se está abriendo paso rápidamente también en el servicio marítimo en donde se le está aplicando con buen éxito por razón de sus ventajas que ofrece su empleo, no sólo para impulsar pequeños botes sino también en las grandes máquinas y aun en los buques de guerra.

Es imposible poder predecir hasta dónde se extenderá el empleo del petróleo como generador de fuerza, pero sí puede afirmarse que la edad del petróleo apenas principia y que las empresas petrolíferas, así como las refinerías están destinadas a aumentar su importancia con gran rapidez durante los años venideros.

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THE MEXICAN MINING JOURNAL

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Petroleum Industry of Mexico.

This Journal learns from an authoritative source, to which source it here expresses its sincerest gratitude, that the total production of the Mexican oil fields, during 1914, is estimated to have been about 32,000,000 barrels. Of this total about 17,650,000 barrels were exported, and of the balance 5,700,000 barrels were destined for domestic consumption and the Mexican refineries, and some 9,000,000 went to increase the stocks in storage.

According to the Mexican Year Book for 1914 the production of the oil fields for 1913 totalled 26,000,000 barrels, compared with 16,558,215 barrels in 1912, which was 4.71 per cent of the world's production. From 1900 to 1906 the production averaged 1,000,000 barrels. During 1913 the Cia. Mexicana de Petroleo "El Aguila" and one other company contributed more than 90 per cent of the total. At the end of 1913 there were more than 20 separate fields developing in the Tampico region. The area held for petroleum operations comprises about 5,000,000 acres as compared with 8,322,862 acres held in the United States in 1911 for oil and gas purposes. At least three individual companies operating in the Tampico field hold greater acreages than those reported for the state of California. All the oil so far developed is of the low-gravity, asphalt base, hitherto not considered so desirable as petroleums of a paraffin base. However, as new uses for petroleum products are developed and improved methods of refining are perfected, the disadvantages of the asphalt oils as compared with the paraffin petroleums are becoming less apparent.

It thus appears that in spite of the disturbed conditions of the country, the great oil industry of Mexico increased its production during 1914 by 6,000,000 barrels as compared with the output of the preceding year. It seems to have suffered less than other branches of the mining industry. The geographical position of the fields no doubt contributed much to this apparent immunity. Whether the oil men will be as fortunate during the current year remains to be seen. The very extent of the industry and its importance to the world will, we hope, tend to prevent interference with its continued development. With the enormous increase of the use of petroleum for ship propulsion and the growing dependence of civilization upon explosive motors, the world can ill afford interference, even for a few months, with the normal production of crude oil, and in that lies a great hope for this stricken country.

Element of Economy in "No Hay."

We have all smiled at the innocent remark of the callow Gringo, fresh from the States, who found that "No hay" was the most plentiful thing in Mexico. That same commodity, which has become almost uni-

versal owing to lack of transportation, has during the past few months taught many of us how far we may stray from the basis of true economy in normal times without in the least realizing where we were going. Mining companies, especially those interested in smaller enterprises, which in normal times considered it impossible to continue operations for a week when cut from their sources of supplies, have found an amazing ability to "do without" when circumstances compelled them to dig into their stores and improvise ways and means. And not a few of them will arrange their orders for supplies in a very different manner when the normal up-keep again becomes possible. A well stocked store is, of course, a real economy as well as a convenience, but necessity should determine when it is to be drawn upon and not haste or convenience, and there is nothing that will teach what actual necessity is, like necessity itself.

There are, no doubt, many concerns who prided themselves on the care with which their order lists for supplies were scrutinized, who have still learned many surprisings things during this period of enforced "No hay." In prosperous mills standard supplies, like pipe-fittings, bolts and nuts, belt lacings and fasteners, are too often used freely as one uses air and water, without thought as to where they come from or what they cost. There was the case, some years ago, of a lixiviation mill where bronze valves were used to handle the extremely corrosive mill solutions. There was a good store, and there was no occasion to check up the outflow of pipe fittings. It was not discovered until months had gone by that these valves, costing some 15 pesos apiece, lasted in use only a few days at most. Had "no hay" intervened more promptly, it would not have taken months to discover that a rubber hose and a clamp are a cheap and satisfactory substitute.

It is the fashion among certain engineers to despise economy in standard supplies. They hold, with a certain amount of truth ,that no plant can be efficient unless it is kept strictly up to the mark, down to the last screw, and that time spent in "making things do," is so much time wasted. Much must be sacrificed for efficiency, but in this as in everything else "it all depends." The example of another lixiviatiton mill might be cited. In that mill "No hay" was deliberately practiced as a measure of economy. Buildings were roofed with old oil tins, pipe lines were kept together by bandages of rags instead of couplings. Yet that mill paid annually 100 per cent on its capital invested and achieved costs per ton below anything ever accomplished before or probably since.

There is another case of a mine and mill which in normal times had a pay-roll of 9000 pesos weekly and a store expense of 8000 pesos. A hundred eagle eyes constantly scrutinized that pay-roll, while the lists for supplies, which flowed in a steady stream from the place, received an occasional glance from the single busy clerk through whose hands all orders passed. Perhaps, if it survives, this plant may see another system before long.

The Reduction Process in Mexican Cyaniding.

When a year or more ago the Nipissing engineers announced the success of the process they had evolved for the liberation of silver from complex minerals by means of reduction by hydrogen, the announcement aroused great interest in this country, because of the abundance of ores of that kind especially in the southern part of the republic. Since then conditions have been so disturbed that operation has been difficult if not impossible, and any important improvement in practice has been out of the question. There have been no installations of the new process, but enough work has been done to show that reduction is likely to prove useful in several localities. One company has found that reduction will materially reduce the losses in its tailings and another proposes to treat its concentrates by the process as soon as supplies of the necessary chemicals are available.

The reduction idea offers great opportunities to the cyanide chemist, for the principles of the process are essentially chemical and its development is not likely to be monopolized by the mechanical manipulator. So much remains to be done before its possibilities are exhausted that it is not likely to be standardized for a long time to come. Enough work has already been done to prove that neither sodium hydrate or aluminum is essential to the process. The necessary condition is a strongly reducing atmosphere, and that may be obtained in various ways. This gives many chances for the exercise of ingenuity in adapting local materials and local conditions to the problem in hand. A number of points have come to light which may suggest possibilities to those still in the field and so fortunate as to be able to work.

Sodium amalgam, formerly much used on amalgamation plates, evolves hydrogen when in contact with water or aqueous solutions. Some years ago it was discovered that tellurides of gold were readily broken up into their component parts when brought into contact with this combination of sodium and mercury. In mills troubled with coarse gold and ruby silver minerals, experiments with plates and sodium amalgam might offer certain possibilities.

Many of us recall the amusing story of a young operator of a cyanide mill, a story told years before reduction was seriously thought of. When asked why he fed zinc into his mills when it normally belongs only in the precipitation department, he replied that he didn't know why he did such an outlandish thing except that it was the only way he could get a decent extraction. Zinc in an ordinary lime solution does have the desired reducing effect, although the action is much less rapid and powerful than with aluminum and sodium hydrate. The average cyanide man would gasp at this young man's extraordinary procedure, for the presence of zinc would immediately precipitate all metals already in solution, and are there not traditions of reprecipitation and its disastrous consequences? Silver precipitated from cyanide solution seems to redissolve readily enough after the precipitant has been removed. Not that this young cyanider's practice

is to be recommended for all and sundry, but there is a suggestion in it.

A few promising results have been obtained in securing the release of silver from rebellious minerals by means of the acetalin generated, in the agitation pulp, from ordinary carbide. One trouble with this reducing agent lies in its slight solubility in water. Unless the reducing agent is completely removed solution can obviously not take place. Possibly a restricted use of the reagent or a thorough aeration might remove this difficulty.

These suggestions are—merely suggestions. They may have no value and may be dangerous in the hands of a nocive. At least they are not subject to mechanical exploitation.

The American Society of Mexico.

During the past month the officers of the new American Society of Mexico have been extremely active in gathering information and in perfecting plans for its real work which will not begin until communication with different parts of the country again becomes possible. A matter which comes first, both in time and importance, is the registry of every name of every American citizen upon the records of the society, with his or her place of residence, and every bit of information that may be of only minor interest now but which may rise to the utmost importance at any moment.

Next to knowing where every American in Mexico is and what he is doing, the society must have the support of the maximum number of their countrymen and countrywomen, whom the society represents and in whose interests it has been founded. The effect of any action of the society will be directly proportional to the percentage of Americans who are actually behind it. The committees who undertook to represent American interests in this country four years ago, actually represented only a small group of their countrymen resident in Mexico City, and everybody is familiar with the results of their activity. The men in the mining camps had no knowledge of the existence of these committees, and the members of the committees had not the slightest idea as to the hopes and fears of the men in the camps, nor of their thoughts and opinions. It was the old story of representatives who do not represent.

All of this the present officers of the American Society mean to avoid. In order to help you they must know where you are what you are doing, and in order to represent you correctly they must know which of their actions you will be inclined to back. This is your society; you know you need some force at head quarters to look after your interests. Get in line behind it!

We have been asked what the American Society proposes to do for the lone Gringo who is trying to work a small claim away back in the hills. If that Gringo antagonizes the authorities of the country and fails to live up to the rules and regulations, it can do nothing for him. But there is bound to be a new set of rules and regulations, and if these bear too heavily on him the society can use its influence, in an entirely friendly way, to see that he gets a square deal. If he is attacked by bandits the society may not be able to save his life, but it can at least demand punishment where it belongs and notify friends and relatives in the States what has become of him.

But this is not all that the society will do. When reconstruction begins, its influence will be constantly felt. Brains and exact information will be in demand, and it is the business of the society to furnish both these commodities.

Colonel Tepetate.

The Pessimist caught him loafing through a copy of a mining journal. It was an old copy and showed signs of wear.

"What? Still reading those things?"

"Sometimes! "replied the Colonel, shoving the offinding publication into his pocket." I always read the personals, and generally see if there are any new advertisements. I might as well own up and admit that I usually find at least one article in this journal that interests me. Any objections?"

"Technical journals are all the same, "said the Pessimst." A pure waste of time. They pretend to get together stuff which will be of some help to the engineer, and how do they do it? I met a general manager the other day—he knows what he is talking about, too—a really big noise. He said that of all the volumes and tons of stuff written about cyaniding, there are only two articles—descriptions of mills, they are—that could be of any use or benefit to anybody."

"Huh!" mused the old man becoming interested." I see. It is the poor mining journalist that you are out to knock this time. Well, I suppose they can stand it as well as anybody. Poor devils! Theirs is a thankless job at best, and now when nobody wants to real anything but war—"

"Why don't they give some real stuff?"

"What's eating you, anyhow? I know you read the mining journals, every one you can lay hands on, and so do I. When we say we don't, we are only working a sort of superior pose, supposed to be intellectual, and we follow along with the crowd. A show of contempt for books and printed matter is fashionable. We don't really feel so all-fired superior, and we read more than we ever did before. You haven't told me what set you off on this particular tack."

"To tell you the truth," began the Pessimist, doing his best to look modest. "I have been getting at that article on my mill, and have been looking over some "old stuff to see how the other fellows did it."

"Ah! Now I see," exclaimed the enlightened Colonel. That same article you've been going to write for the past three years. You'd better get a move on, or you'll be away out of date. Most mills are back numbers before they are finished. It is too early yet for the last word as to cyanide mills. I know precisely how you feel. I've been there myself. Your mill is a

crackajack—at least it was four years ago. You are naturally proud of it, and you know more about it than about anything else. You look through tons of articles on other mills, and you fail to find the pep that you want to put in yours. You're going to show 'em, By Heck! Something epoch-making, like the ones your general manager friend told you about. Go to it 'I'll read it even though nobody else does."

"Huh! You seem to think I can't do it!"

"In order to write anything worth while, you've got to think straight and to have a good idea as to what's important. You may not have noticed it, but what's important and what's interesting come to just about the same thing. Tell me, what's wrong with all those articles you've been knocking?"

"Oh, they give you pictures, and a list of the machines, the grade of launders, and all that, but they tell you nothing about what the mill does. The only important things about my mill or any mill, are tonnage, extraction and costs, first costs, repair costs, labor costs, every thing figured per ton."

"Yes, those are the figures that mean everything to you. But do you think anybody on the other side of the world would care a rap for them. Those figures all depend upon conditions, and conditions are never twice the same. Besides, I wouldn't believe any superintendent's statement about cost per ton under oath, percentage extraction still less. A man who consents to publish matters so purely personal as that always wants to make a good showing. He selects a period which he calls normal, but which in reality is favorable to show up the point he wants to make. The result is, not exactly a lie, but at at least a brother or a cousin to it."

"Then what's your idea as to a fine article?"

"I don't believe in epoch-making articles at all. A man who writes sincerely doesn't start out by saying that he knows more about this subject than anybody else. He merely says what he has seen and done, and then stops. If he trots out one little idea that is new to twenty per cent of his readers, he is doing mighty well."

"That's exactly what I object to. You get nothing."

"The result may not be worth clipping and card-indexing, but the sum of thousands of observations by thousands of men make up the mass of technical literature and progress."

"Most of the stuff has no authority because the men who write it have no standing."

"What kind of standing, financial, technical?"

"You know what I mean, the men who do things."

"Yes, I know what you mean. You mean men who have made money in the mining business. Making money in the mining business depends upon so many things for which the man is not in the least responsible, that pride in or respect for that sort of standing does not appeal to the average reader. Anyhow, if is is true and interesting—Excuse me, I should have said, important—I don't see what difference it makes who writes it."

"It's a waste of time reading journals that give you so little, the magazines too, for that matter."

The old man nodded. "Yes, "he said. "Why don't you add that 'Time is money' and the rest of that old dope. The hypocrite who talks about, 'no time to read,' these days ought to be kicked across the Alameda. Show me any white man who knows how to read and who doesn't spend two hours a day over newspapers, three fourths of which he knows can't be true, and the other fourth of no matter of concern to him! The big men who talk the most about 'Time is money' sit around an office in Wall street from 10 A. M. to 3 P. M. with two hours for luncheon. There isn't a mothers' son of them that doesn't loaf, actually loaf, from three to ten hours more per day than the fellow who keeps shift hours."

"Do you keep a file of clippings?"

"I started one, but like everybody else, I quit somewhere between the eleventh and the twelfth month. You write your article and find me those mentioned by your general manager friend, and I'll have them framed in gilt frames and hang them-in the bed-room."

Colombia Seeks Foreign Enterprise and Immigration.

The Colombian Consul in Mexico is distributing a booklet designed to encourage immigration in that country and to induce capital and enterprise to undertake the development of the great natural riches of the interior. According to competent observers quoted Colombia has a soil and climate capable of supporting ten times the present number of inhabitants. Although so near the equator it can furnish practically every climate desired, for its habitable territory varies in altitude from sea level to eighteen thousand feet. The seaports through which one must enter the republic are hot and disagreeable, but over most of the territory the climate to a New Englander would seem like perpetual spring. The opening of the Panama canal places Colombia at the junction of some of the world's most important trade routes, and the time seems to be well chosen for making the advantages of that country more widely known.

Of mineral resources Colombia possesses deposits which yield gold, silver, platinum, copper, lead, coal and iron. The platinum workings are next to those of Russia in importance. The emerald mines are a monopoly of the goverment and worked under lease. Petroleum fields are attracting the attention of capital, and there are important deposits of asphalt. Water power possibilities are said to be enormous, and transportation which is still difficult in the interior, being mainly along the rivers by steamer, is in the course of improvement by the construction of railroads.

The country has now enjoyed peace and stable government for fifteen years, and its people believe that they have definitely passed the period of revolutions and turmoils which is the part of every Latin-American republic. The population is said to be mainly white, of a total of nearly five and half millions, only three hundred thousand being of Indian. Of all the Latin-American republics Mexico has the largest proportion of Indian population.

The State of Sinaloa.

Sinaloa is the second State south of the American line on the Pacific Coast of Mexico. Its northern line is 260 miles due south of the southwest corner of New Mexico and 600 miles due west of Corpus Christi, Tex. With reference to important United States markets, it is located as follows: Almost exactly southwest of Kansas City and Chicago, 1100 and 1500 miles, respectively, and southeast of Los Angeles and San Francisco 750 and 1150 miles, respectively.

Geography and Topography.

Sinaloa is about 350 miles long and from 50 to 150 miles wide, tapering from north to south; bounded on the west by the Pacific Ocean and the Gulf of California, on the north by the State of Sonora, on the east by Chihuahua and Durango, and on the south by the Pacific Ocean and the Territory of Tepic.

The entire eastern side of the State is taken up by the Sierra Madre Mountains, which slope southwesterly to the ocean and the Gulf of California and throughout their foothills toward the coast in a jagged line. At numerous points, such as Topolobampo, Las Vegas and Mazatlán, the hills jut into the sea and at no place in the State are they more than forty miles from salt water.

Throughout most of the length of the State there is a coastal plain, varying from one to forty miles in width. Four-fifths of this plain, and therefore the greater part of the State's agricultural possibilities, is along the coast from the San Lorenzo River north. This coastal plain, with its small ramifications into the foothills, occupies approximately 20 per cent. of the 17,500,000 acres which comprise the State, the remaining 80 per cent. being divided about equally between mountains and foothills. The highest elevation in Sinaloa is 800 feet, the eastern line being at all points below the crest of the Sierra Madres. The coastal plain generally breaks into hills at an elevation of from 100 to 300 feet. Very little first-class agricultural land is found above 1000 feet elevation, it being a noticeable fact in Sinaloa that where the land is good it is practically all good, and where it is broken it is nearly all broken and of little use for cultivation, except with a crowbar.

History.

According to Aztec records now preserved in the National Museum of Mexico, the Culiacan Valley in the State of Sinaloa, is the birthplace of that nation and the cradle of its religion. In the year A.D. 552 the Toltec tribe of this race arrived at the Culiacan Valley and made the settlement, which is now called by the same name. Space will not permit even a mention of all the doings of these people during the 1000 years following this date, but that they were progressive and industrious is shown by the records made at the time of the Spanish invasion.

When, in 1530, Nuno de Guzman, president of the Royal Audience of Mexico, reached this valley he was met by an organized and well-clothed army of 30,000 men. He found large stores of cotton goods and large quantities of food, such as corn, beans, fruits and various vegetables; also quantities of silver and some bronze. The battle which followed his arrival at Mocurimi was short and a decisive victory for Guzman, who then explored the valley as far as the sea and returned to Culiacan, where he remained several months receiving tribute from over 200 villages.

During the French invasion Maximilian's forces suffered a defeat at San Pedro, twelve miles west of Culiacan, December 22, 1864, the date being set aside as a State holiday in honor of the event. Thus we find that Sinaloa has been making history for more than thirteen and a half centuries and has played no small part in the affairs of the Mexican nation.

Climate.

Sinaloa has within her boundaries many varieties of climate, from the tropical heat of the valleys to the cold and temperate climate of the high mountains. All who have visited Culiacan or Mazatlan between October and June agree that the climate is much preferable to that of Southern California, being more even and not subject to violent changes. In the summer, which is the rainy season, the heat is felt most, but the maximum thermometer reading for the past twenty years is 102 deg. in the shade. The nights are generally cool and agreeable and even the heat of the midday sun is not felt nearly so much as the summer heat of Chicago and New York. Sunstrokes are unheard of and the writer believes that with modern American conveniences, even the summers will be quite as agreeable as in Southern California.

Water Supply.

Government records, extending back over a period of twenty years, show the average rainfall of Culiacan to be about 30 inches, ranging from 55 down to 18 inches. The fall is almost entirely in the growing season and is ample for one good crop without artificial irrigation, and there are some lands which are producing two good crops per year under the rainfall alone.

Sinaloa is crossed by ten rivers of considerable size, which provide abundant water for the lands adjacent to them. In the coastal plain water is found at from sixteen to fifty feet, generally in quantities sufficient for irrigation by pump, and much of the agricultural land of the State will in time be irrigated by this method, as wood is both plentiful and cheap and an abundance of electric power will be developed from the falls in the rivers by the time there is a demand for it.

Soil.

The river valleys are made up of rich river silt, very deep and exceedingly fertile. This is free working soil and scours tools, to the farmers delight. On the mesas a few miles back from the streams the soil is of greater consistency and runs into a heavy clayish formation, but there is generally a good percentage of sand and organic matter. Some of this is as sticky as the famous "black waxie" of Texas and quite as productive, as it never wears out. In a few foothill districts the slopes are covered with a rich, loose soil several feet in depth, but in much of the hill country the rock is exposed or only thinly overlaid with dirt, and the vegetation is light. In the mountains there is usually some soil, and the slopes, although very steep, yield corn, but can only be farmed in the native style with crowbars and machetes. Some farmers prefer that section, because they are able to cultivate both sides of their land.

Timber.

In some respects Sinaloa has been overrated for timber, as she contains very little saw pine and none which is now accessible, but what is lacking in quantity is made up in quality and variety of hardwoods, which are a delight to the cabinet-maker. There is some

magnificent mahogany, ebony, maple, rosewood, lignum vitae, mora, yellow wood and others of equal beauty and worth. Rosewood is a favorite among the natives for fence posts and ebony their choice for gate posts and porch pillars. Most of the coastal plain is covered with scrub timber, seldom more than twenty feet

high, and with few trees that exceed two feet in diameter, except along the rivers. Many of these lowlands, however, have fuel wood sufficient to pay for their clearing, as labor is cheap and there is some demand for wood for running pumping plants, sugar factories and for domestic use.

Grazing.

The greater part of the coast lands are covered with a dense growth of woods, brush and some grass, but grass itself is seldom abundant in the lowlands except in the salt marshes. The weed and brush growth on much of the land will support more stock to a given area than the famous bunch grass region of the Northwest. In the foothills and mountains there are some magnificent grazing lands, with ideal conditions for stock-raising and a climate that is unsurpassed.

Products.

The principal products at present are corn, beans, garbanzos, peas and sugar, both refined and crude. Alfalfa has been successfully grown in two places. Bananas, oranges, lemons, mangoes, cherimoyas, known as the vegetable ice cream, and one of the most delicious of fruits, grow in abundance in the mountain valleys, and the melon papaya, or tree muskmelon, from which is extracted the purest form of pepsin known to the drug trade, furnishes a cheap and healthful food. Plums, strawberries, blackberries and grapes are grown in various parts of the State. Peaches, apples and pears do well in the mountains, and all vegetables common to the American table are grown here in the winter months and can now be delivered to the markets of the United States, when even Southern California finds it impossible to mature many of the more tender varieties, such as egg plant, cucumbers, cantaloupes, watermelons, etc. Almost every product of Southern California can be produced in Sinaloa as well as in any part of the United States. All farm products are in strong demand and good prices in the local market.

Mescal or henequin, the fiber plant, known as the millionaire maker of Yucatán, is indigenous to Sinaloa, growing wild in great abundance. This is one of the easiest crops grown, requiring no irrigation and but little cultivation. The plant is exceedingly hardy and prolific and the returns are large and practically certain. The market for the fiber is assured, as the twine and cordage mills of the United States can use more than the entire crop for many years, while Europe and South America are now bidding against the United States for the crop.

Mines.

The eastern or mountainous portion of the State is rich in mineral resources and, when properly exploited, will undoubtedly develop into one of the most wonderful mining regions of the world. Even with no more effiecient means of transportation than pack mules, and with only crude machinery and improper management, many properties have been developed from their own output into mines paying large profits. Two mines of this class that should be mentioned are the San Jose de Gracia and the Guadalupe de Los Reyes, each with a recorded output of more than a million a year for many successive years. One of the few mines of the State that has had the advantages of modern machinery and good management is the Tajo of the Rosaria district, in the southern part of the State.

The three mines mentioned are only examples of what has been done in the mines of Sinaloa. If so much has been possible under the most adverse conditions, what may we not expect from Sinaloa's mineral region with railroad transportation, up-to-date mining machinery and the application of modern business methods.

Transportation Facilities.

The development of Sinaloa has been retarded heretofore by lack of transportation facilities, being isolated from the rest of the republic and all of the United States by hundreds of miles of mountain country, but the building of the Southern Pacific Railroad line through the entire length of the State has entirely revolutionized local conditions and brings her in close touch with the central plateau of Mexico, with her strong markets, as well as with the United States markets, on the north. The great development which is going on in the State has already attracted a number of powerful navigation lines, Mazatlan, Altata and Topolobampo being regular ports of call for a number of American, English, Canadian, German, French and Japanese liners, thus making it impossible for the commerce of the State to be restricted by high rates, as no point in Sinaloa can be over 150 miles from a seaport and none of the good tillable land but can find a water outlet within seventy-five miles. The Southern Pacific line traverses the center of the coastal plain, generally about twenty miles from the sea, so the great producing section is directly tributary to its rails.

Communication.

Telephone and telegraph lines, under direction of Ferderal and State goverment, with rates much cheaper than in the United States, reach the principal centers of the State, and a good mail service is maintained over the railroad, and mounted carriers reach all parts of the State. In addition, many steamers which ply the coast carry both mail and passengers.

Real de Xichu Mining District.

The mineral district of Xichu is located in northeastern Guanajuato, some 90 kilometers from San Luis de La Paz, a station on the Rincon-Pozos branch of the Mexican National railway. Half of the trip, or to Victoria, is over the mesa and can be easily made by coach, but from Victoria to the foot of the Sierra Gorda, the road follows the rocky sides of an arroyo, and is useless for vehicles, while over the mountains there are but few stretches suitable for anything but pack or saddle animals. Through the valley of the Rio de Xichu, in which the town of the same name and the mines are located, is a well constructed mountain road cut out of the solid rock in some places and built up of rough masonery in others. On the western side of the mountains the country is arid and vegetation scant, aside from cactus and maguey, which are abundant, with pepper trees, sycamores, acacias, cotton woods, etc., along the water courses. On the crest and eastern mountain slopes are dense forests and the vegetation is both of Atlantic and Pacific coast types. Lower down the pines give way to the trees of the warm temperature and torrid zones. The rainy season lasts but a few months during the year, the river furnishing water continuously for irrigation. The valley is V shaped, with numerous branches, and descends sharply to the northeast. The surrounding mountains are from 100 to 500 meters above the river, and the town of Xichu is about 1,600 meters above sea level.

As a mineral producing district, Xichu dates back to considerable antiquity, and all through the mountains are openings made by the early workers, the age

of which is problematical, but many show proof of having been made with the aid of fire, which indicates that they antedate the days of the conquistadores. As evidence of former industrial activity, there are ruins of a half dozen or more old smelters scattered up and down the valley. The residents of Xichu state that these antiguas were constructed 200 years or more ago. They are invariably built against a hillside, which carried a water ditch that furnished the blast, an idea copied from the Trompe used in the Pyrenees. The higher structure conducted the water to the air compressing chamber, now gone. The chimney in which the smelting was done. Some good sized piles front carried off the fumes from the open hearth in of slag are near these old plants and a sample from one assayed 400 gm. silver, 22 gm. gold, indicating either poor work on the part of the old metallurgists, or unusually rich ore, and also a possible source of profit for some enterprising individual who cares to investigate.

TABLE OF PROTECTIVE ALKALINITIES IN KILOS OF CaO PER METRIC TON FOR DIFFERENT STRENGTHS OF CYANIDE SOLUTION.

Alk	.00	.005	.01	.015	.02	.025	.03	.035	.04	.045	.05	.055	.06	.065	.07	.075	.08	.085	.09	.095	.10	.105	.11	.115	.12	.125	.13	.135	.14	.145	.15
1	.028	.0065																													
2	.056	.034	.013																												
3	.084	.062	.041	.019																											
4	.112	.090	.069	.047	.026	.004																									
5	.140	.118	.097	.075	.054	.032	.011																								
6	.168	.146	.125	.103	.082	.060	.039	.017																							
7	.196	.174	.153	.131	.110	.088	.067	.045	.024	.002																					
8	.224	.202	.181	.159	.138	.116	.095	.073	.052	.030	.009																				
9	.252	.230	.209	.187	.166	.144	.123	.101	.080	.058	.037	.015																			
10	.280	.258	.237	.215	.194	.172	.151	.129	.108	.086	.065	.043	.022	Tr																	
11	.308	.286	.265	.243	.222	.200	.179	.157	.136	.114	.093	.071	.050	.028	.007																
12	.336	.314	.293	.271	.250	.228	.207	.185,	.164	.142	.121	.099	.078	.056	.035	.013															
13	.364	.342	.321	.299	.278	.256	.235	.213	.192	.170	.144	.127	.106	.084	.063	.041	.020														
14	.392	.370	.349	.327	.306	.284	.263	.241	.220	.198	.177	.155	.134	.112	.091	.069	.048	.026	.005												
15	.420	.398	.377	.355	.334	.312.	.291	.269	.248	.226	.205	.183,	.162	.143	.119	.097	.076	.054	.033	.011											
16	.448	.426	.405	.383	.362	.340	.319	.297	.276	.254	.233	.211	.190	.168	.147	.125	.104	.082	.061	.039	.018										
17	.476	.454	.433	.411	.390	.368	.347	.325	.304	.282	.261	.239	.218	.196	.175	.153	.132	.110	.089	.067	.046	.024	.003								
18	.504	.482	.466	.439	.418	.396	.375	.353	.332	.310	.289	.267,	.246	.224	.203	.181	.160	.138	.117	.095	.074	.052	.031	.009							
19	.532	.510	.489	.467	.446	.424	.403	.381	.360	.338	.317	.295	.274	.252	.231	.209	.188	.166	.145	.123	.102	.080	.059	.037	.016						
20	.560	.538	.517	.495	.474	.452	.431	.409	.388	.366	.345	.323	.302	.280	.259	.237	.216	.194	.173	.151	.130	.108	.087	.065	.044	.022	.001				
21	.588	.566	.545	.523	.500	.480	.459	.437	.416	.394	.373	.351	.330	.308	.287	.265	.244	.222	.201	.179	.158	.136	.115	.093	.072	.050	.029	.007			
22	.616	.594	.573	.551	.503	.500	.487	.465	.444	.422	.401	.379	.358	.336	.315	.293	.272	.250	.229	.207	.186	.164	.143	.121	.100	.078	.057	.035	.014		
23	.644	.622	.601	.579	.558	.536	.515	.493	.472	.450	.429	.407	.386	.364	.343	.321	.300	.278	.257	.235	.214	.192	.171	.149	.128	.106	.085	.063	.042	.020	
24	.672	.650	.629	.617	.586	.564	.543	.521	.500	.478	.457	.435	.414	.392	.371	.349	.328	.306	.285	.263	.242	.220	.199	.177	.156	.134	.113	.091	.070	.048	.027
25	.700	.678	.657	.635	.614	.592.	.571	.549	.528	.506	.485	.463	.442	.420	.399	.377	.356	.334	.313	.291	.270	.248	.227	.205	.184	.162	.141	.119	.098	.076	.055
26	.728	.706	.685	.663	.642	.620	.599	.577	.556	.534	.513	.491	.470	.448	.427	.405	.384	.362	.341	.319	.298	.276	.255	.233	.212	.190	.169	.147	.126	.104	.083
27	.756	.734	.713	.691	.670	.648	.627	.605	.584	.562	.541	.519	.498	.476	.455	.433	.412	.390	.369	.347	.326	.304	.283	.261	.240	.218	.197	.175	.154	.132	.111
28	.784	.762	.741	.719	.698	.676	.655	.633	.612	.590	.569	.547	.526	.504	.483	.461	.440	.418	.397	.375	.354	.332	.311	.289	.268	.246	.225	.203	.182	.160	.139
29	.812	.790	.769	.747	.726	.704	.683	.661	.640	.618	.597	.575	.554	.532	.511	.489	.468	.446	.425	.403	.382	.360	.339	.317	.296	.274	.253	.231	.210	.188	.167
30	.840	.818	.797	.775	.754	.732	.711	.689	.668	.646	.625	.603	.582	.560	.539	.517	.496	.574	.453	.431	.410	.388	.367	.345	.324	.302	.281	.259	.238	.216	.195
31	.868	.846	.825	.803	.782	.760	.739	.717	.696	.674	.653	.631	.610	.588	.567	.545	.524	.502	.481	.459	.438	.416	.395,	.373	.352	.330	.309	.287	.266	.244	.223
32	.896	.874	.853	.831	.810	.788	.767	.745	.724	.702	.681	.659	.638	.616	.595	.573	.552	.530	.509	.487	.466	.444	.423	.401	.380	.358	.337	.315	.294	.272	.251
33	.924	.902	.881	.859	.838	.816	.795	.773	.752	.730	.709	.687	.666	.644	.623	.601	.580	.558	.537	.515	.494	.472	.451	.429	.408	.386	.365	.343	.322	.300	.279
34	.952	.930	.909	.887	.866	.844	.823	.801	.780	.758	.737	.715	.694	.672	.651	.629	.608	.586	.565	.543	.522	.500	.479	.457	.436	.414	.393	.371	.350	.328	.307
35	.980	.958	.937	.915	.894	.873	.851	.829	.808	.786	.765	.743	.722	.700	.679	.657	.636	.614.	.593	.571	.550	.528	.507	.485	.464	.442,	.421	.399	.378	.356	.335
36	1.008	.986	.965	.943	.922	.901	.879	.857	.836	.814	.793	.771	.750	.728	.707	.685	.664	.642	.621	.599	.578	.556	.535	.513	.492	.470	.449	.427	.406	.384	.363

cc $\frac{n}{5}$ $H_2S_2O_4$ REDUCED BY 20cc KCy SOL'N OR cc $\frac{n}{10}$ $H_2C_2O_4.2H_2O$ REDUCED BY 10cc KCy SOL'N-10 POINTS ALKALINITY.

A Convenient Alkalinity Table.

Written for the Mexican Mining Journal.

By P. W. Avery Met. Engr. *

The following table, first arranged by Mr. W. J. Sharwood and used by him at the several Homestake plants, has been used at Esperanza for some time and at numerous other plants in the States and Mexico.

The old table was made out in pounds of CaO per short ton of cyanide solution, which necessitated the use of a factor where the metric system was used. This old table has been recomputed expressing the protective in kilos of CaO per metric ton of solution.

An explanation of the method of titration to be used with this table is as follows:

To titrate for alkalinity a N/5 H_2SO_4 or a N/10 H_2CO_4. $2H_2O$ may be used, if a N/5 acid is used then 20 ccs of the cyanide solution should be taken, if a N/10 acid, then 10 ccs should be taken, as every 0.10 cc. burette reading is one point of alkalinity, 1 cc=10 points of alkalinity, etc. Should one for example obtain an alkalinity figure of 10 in a solution free from cyanide, glancing at the table in the zero column one finds 0.28 kilos CaO per metric ton. If the solution carried .02 per cent KCy then the protective will be found to be but 0.194 kilos CaO per metric ton.

If greater strengths of cyanide and lime be used than are given the table may be enlarged to suit the conditions by the use of the following aritmetical computations.

If, for example, 0.20 per cent KCy is the strongest solution used and 55 the highest alkalinity figure, to compute the protective we will have:

.005 per cent KCy has an alkalinity=.043 lbs. CaO per short ton or .0215 kilos per metric ton.

$$\frac{0.20}{.005} = 40. \quad .0215 \times 40 = 0.860 \text{ kilos CaO.}$$

1 point alkalinity=.056 lbs. CaO per short ton or. .028 kilos per metric ton. $.028 \times 55 = 1.54$ $1.54 - 0.860 = 0.68$ kilos CaO (protective) per metric ton solution for the KCy and alkali strength given.

Wolfram.

Argentina and Bolivia export annually over 500 tons of wolfram. This is the most commonly known of the various tungsten ores, and is the tungstate of iron and manganese. It is dark brown, almost black, in color and is very dense and heavy. It frequently is mistaken for iron ore but is heavier than metallic iron itself. It is said to have been first discovered by a Swedish sailing master in 1781. Various tungsten ores are mined and exported by several countries, the chief supplies coming from Queensland, Portugal, Bolivia, Argentina and the United States.

Wolfram is used to make the filaments in incandescent electric lamps. By a method discovered by one of the large electric companies of the United States it is now possible to draw tungsten metal into a wire as fine as one-thousandth of an inch in diameter so that the wire is pliable and can be wound upon spools like sewing thread. It is used in one piece in the lamps and is said not to be so fragile as that produced by certain methods used in the German product. The tungsten wire, as drawn out for this purpose, is very strong, it being claimed that it has more strength than any steel piano wire that was ever made. The specific gravity of tungsten metal is given as 19.12, almost as much as that of gold, which is 19.3.

The discovery of this metal for making filaments has caused an enormous saving to the consumers of electric light the world over. It enables the consumer to obtain two or three times the quantity of light at about one-half the consumption of electricity formerly used by the old carbon lamp.

The principal use of tungsten, however, is to harden steel, especially the steel of which tools are made. The tool steel of the present day is said to be nearly all tungsten steel, having from 8 to 20 per cent metallic tungsten mixed with the steel in its manufacture. It is sometimes called "self-hardening steel" because it does not have to be tempered, for with the addition of the metallic tungsten it tempers itself. When heated to a cherry red and allowed to cool, the steel attains its maximum hardness and can be used by machinists for lathe cutting tools and for drills. Machinists tools can be run at much greater speed and it has been estimated that at least four times as much work can be done with the tungsten steel as with the ordinary kind, because the machines can be run four times as fast and that without taking the temper out of the tool when it gets very hot, as is the case with ordinary steel. The president of one of the large automobile manufacturing companies is said to have stated that if there were no such thing as tungsten steel the cost of each automobile would be $200 more than it is now.

Tungsten and its salts are used for making silk and cotton fabrics fireproof; for winding electric furnaces, and for use in the apparatus employed for the utilization of Roentgen rays. Also occasionally in the manufacture of silk in order to add weigth and to give it the desired stiff effect.

* El Oro. Mexico.

The Volcan of Jorullo, Mexico.

By Andres Villafana.

Along the south-western margin of the Central Tableland of Mexico there is a rapid descent to the lowlands of the States of Michoacan, Mexico, and Guerrero.

To the north of the steepest part of the road leading to the volcanic region there cross various narrow valleys inclined to the south and south-west, and a few enclosed basins. These valleys and basins were not formed by recent volcanic action, but simply represent portions of ground not occupied by the basaltic lavas.

Jorullo is situated in latitude N. 18° 15′ 12″ and longitude W. 2° 37′ 13.19″ of Mexico City, at an altitude of 1,320 metres aboved sea level.

The topography before the eruption of September 29, 1759, can be easily traced. The Higuera plateau extended at that time almost with the same slope to the south that it possesses to-day, up to the place now occupied by the principal crater, the waters from which drain into the Huaco river and ravine; the opposite slope, with perhaps greater inclination, descends to the Playa river. This plateau was joined, on its north-western portion, to the Partido mountain, and extended a little beyond it to the south-west and west-north-west. The higher portion of the plateau suffered the greatest changes on the appearance of the volcano. The Partido mountain formed the highest portion of a "loma" which extended with gentle slope to the south, west, and north-west, and separated by valleys of little importance from Las Pilas and Veladero hills; the northern slope of the "loma" supplied its waters to the

* Abstracted from "Parergones del Instituto Geológico de México," Vol II., No. 3.

Playa river, while the southern slope yielded its waters to the river which existed at the foot of the Peña Blanca mountain, to be united later to the same Playa river. The latter had its course a little south of its present position, the change of direction having been caused by the invasion of lavas. The river which flows from the Palmo Cuata mountain was interrupted in its course by the formation of a big dyke of lava and volcanic sand, whereby it actually empties itself into the Alberca Grande. The stream which passes between the Saucito and Bonete mountains was equally interrupted, and now flows into the Alberca Chica. The small streams which must have existed between the Higuera plateau, the Partido mountain, and the hills to the south-west, disappeared, leaving their places occupied by "El Malpais." Lastly, the stream which now follows the ravine of Guayabal was then less steep, and a little to the north of its present position.

The configuration of the region is now extremely broken. On the west and north-west exist small valleys arranged in steps, formed by lava streams, and now known as "El Malpais" ('the bad land"). In the latter the cliffs exist which limit the different lava flows, and the small ravines which run from east to west.

The series of volcanic cones comprises "Volcancito Sur," "Volcancito Intermedio," "El Jorullo" proper, and "Volcancito del Norte." Between the Intermedio and Jorullo is a pile of volcanic sand, forming a small plateau, and, between Jorullo and the "Volcancito del Norte," is the great accumulation of lava of the last flow, occuping the northern slope of the principal cone. The remaining four lava streams are to the west of the above.

It should be noted here that the Peña Blanca and Veladero mountains are characteristic volcanic cones of an epoch anterior to Jorullo, and that the lower or southern and western portions of Malpais alone contain remains of the little ovens ("hornitos") or small eruptive cones, to which Humboldt first drew attention.

The first paroxysm, which resulted in the formation of Jorullo, occurred on the nights of September 28 and 29, 1759. For two months previously the inhabitants of the fertile valley[1] were startled by subterranean noises and earthquakes. The phenomena were no doubt the result of the opening of the conduit necessary for the free egress of the volcanic materials.

On September 28 there was a rain of fine sand (volcanic ash?), which should be attributed to the mechanical effect produced by the opening and rending of the rocks during the formation of the conduit, rather than as a manifestation of the eruption proper.

The lava probably emanated from a reservoir in the quartzose diorite which forms the subsoil of the region, being a prolongation of the formation of the Peña Blanca mountain, and of the ravine of El Huaco, and which was already partly covered by steams of basalt, as seen in the Higuera plateau. The deep reservoir of lava was accompanied by a large quantity of vapour of water which, by partial consolidation of the former, was free to exercise its impulse on the surrounding formation. Thus the overlying crust opened from below upwards, with a tendency to produce either elevation in the central part with lateral fissures, or one or more isolated and open chimneys by re-fusion of the rock, and the force of tension of lava in an igneous state and charged with superheated steam. The latter was the case at Jorullo, probably because the formation was not very elestic, and consisted of a crust relatively small in thickness.

Each local chimney subsequently became a volcanic cone, that of "Volcancito del Sur" being the last one formed.

The form of the principal crater, the intimate admixture of quartzose diorite and lava, the existence of fragments of basalt enclosed in the lavas of the principal crater, are in favour of the above hypothesis.

The fluidity of the basaltic lava, which constitute Malpais, is sufficient to explain the formation of the little oven ("hornitos") described by Humboldt. These are little cones, formed of pieces of lava cemented by ash. having the consistency of marl, and which covers them almost in concentric layers. The fluidity of the lava was due, in part, to superheated steam and gases which escaped with it by a fissure or chimney, and such gases and steam, on being expelled by cooling, would produce a phenomenon analagous to what chemists term "spurting" ("galleo.") This phenomenon was very pronounced in the lava of the first flow, producing simultaneously, by rapid cooling, a large number of piles of lava rocks, and a violent emission of gases; the accumulation of lava rocks was afterwards covered by the sand and cinder (lapilli) of the paroxysm, together with wet sands from the rain of mud which then invaded the region.

The "hornitos" are now almost destroyed, but in 1803, or forty-four year after their formation, Humboldt saw "smoke" (vapours) still escaping from them in abundance. In 1872, however, Joseph Burkart noted the destruction and change in form of a great number of them, and, at that date, no steam or gases were escaping from them.

"The "hornitos" are found only in the two lowermost streams of lava, indicating a difference in the fluidity of the different emissions of lava from the volcano. The first lava stream reached a distance of from 4 to 4½ kilometers; the second, 1.8 kilometers, over a slope of slight declivity; the last stream solidified on a slope of 30° to 34°.

After the first flow of lava the crater cones, already enumerated, were formed, consisting chiefly of cinders (lapilli) and bombs, and were covered later by sand.

Of these cones, formed exclusively of fragmentary materials, the principal is Jorullo, succeeded, as regards size, by Volcancito del Norte, the smallest being the almost twin cones of the south. The broken portions of these cones, generally speaking, face west; and it is probable that they were ruptured by lava which escaped in that direction, with the exception of the last stream which broke the upper portion of the principal crater, and escaped northwards.

The paroxysm was therefore effected as follows: A series of earthquakes, due to the re-breaking and superficial movements of rocks during the opening of the conduit or chimney for the egress of the volcanic material , followed by an ejecution of lava from various chimneys, accompanied by large quantities of vapour of water and sulphurous gases, and later by the formation of cones of fragmentary material. In each one of the cones there remained a chimney by which lava flows were effected, and, finally, there was a great emission of sand from the principal crater. After the first flow of lava there was a great rain of ashes which, united with condensed steam and local rains, produced the effect of a rain of mud.

The lavas are plagioclase basalt with much glass. The elements of the volcanic materials—tuffs, sands, and ash—are the same as those of the lavas.

On the borders, and in the interior of the principal crater, are some emissions of vapour of water (fumaroles), the temperatures of which range from 96° to 160° C.

The dominating element of the fumaroles is vapour of water, which is accompanied by much carbonic acid in the one having the highest temperature. Perhaps this steam was formerly charged with sulphuric acid, for, on the east and south-east sides of the crater, incrustation of impure gypsum are seen.

Carnotite Deposits of Colorado and Utah.

The deposits of carnotite in Colorado and Utah have lately attarcted a great deal of attention, for they furnish the most abundant supply of uranium and radium bearing material thus far discovered. The United States now supplies the bulk of the radium of the world, and the development and study of these carnotite beds has already greatly reduced the cost of this rare and interesting element. Carnotite deposits are not common and no finds of the mineral have been reported in Mexico. However, the conditions which led to the formation of the deposits in Utah may possibly have extended down over some districts of the Mexican plateau. The following notes on the deposit were prepared by Frank E. Hess, from data supplied by the Director of the U. S. Geological Survey and have been abstracted from Economic Geology:—

Composition.

Theoretically carnotite is an orthorhombic hydrous potassium uranium vanadate of a canary-yellow color. Another mineral, tyuyamunite, of similar color and the same crystal form and general appearance, contains calcium instead of potassium and it is probable that the so-called carnotite of the Utah and Colorado fields is nearly everywhere a mixture of the carnotite and tyuyamunite, molecules, forming a series which grades at either end into a mineral composed of only one kind of molecule, as do the plagioclases, wolframites, and other series minerals. According to conditions of occurrence, the carnotite may be powdery, friably massive, or sufficiently compact to cut like talc or wax, though the latter form is rare. In many analyses of carnotite, copper and soluble barium compounds are found and it is possible that they may replace the potassium or calcium. The mineral apparently belongs to a group in which the vanadium may be replaced by phosphorus, giving the torbernite series, or by arsenic, giving zeunerite or uranospinite.

Occurrences.

As now known, the principal occurrences of carnotite are in that portion of the high plateau region which lies between the Rocky Mountains of Colorado and the San Rafael Swell of Utah, the Denver & Rio Grande Railroad, and the Arizona-New Mexico line. In this area the main deposits are in the vicinity of Paradox Valley, McIntyre Cañon, Mesa Creek, and Gateway, Colo.; the La Sal Mountains, Dry Valley, Yellow Cat Wash, the San Rafael Swell and the Henry Mountains, Utah. Sporadic deposits outside of this general region occur on Red Creek, Brown's Park, Uinta County, Utah; and in Routt, Rio Blanco and Eagle counties, Colo. As known at present, the richest deposits are those in the vicinity of Paradox Valley, with which is included Long Park.

Carnotite is not a common mineral, and is known at only four other places: Mauch Chunk, Pa.; near Olary, South Australia; at an indefinite locality in the interior of Brazil; and the lime carnotite, tyuyamunite, is found at Tjua-Mujun in the Andijan district, Ferghana goverment, central Asiatic Russia.

Geologic Conditions.

In the main carnotite field of Colorado and Utah carnotite occurs in a nearly white cross-bedded sandstone, which ranges in thickness from 10 to 50 feet. In texture the sandstone is ordinarily medium-grained but in some places is very fine grained and in others is conglomeratic, the pebbles reaching an inch in longest diameter.

Fossilized wood and carbonized reeds or rushes are abundant and there are many bones in the bed. The wood is in the form of tree trunks some of which are as much as six feet in diameter at the base. The ends are rounded, the branches and roots are generally represented only by worn stubs, and the logs show the effect of having been washed from one beach to another before settling to a final resting place. Mr F. H. Knowlton, to whom I submitted specimens collected in 1911, states that the trees grew in a warm climate, as they do not show the annual rings due to periodic growing seasons. He is now studing other specimens collected in the fall of 1913.

Part of the wood is petrified and a smaller part is carbonized. Some is well preserved but some was much decayed before petrifaction. The wood was not petrified until long after it had been covered by later beds, for many logs have been crushed, so that they present oval cross sections. The sandstone is fairly friable and free from clay, and this means that it is not closely cemented and has considerable pore space. Most of the sandstone is cemented by silica, but in part the cement is calcite or gypsum. The characteristics of the sandstone are not particularly different from other beds above and below, and no special reasons dependent upon structure, texture, or composition which would account for the precipitation or segregation of uranium and vanadium minerals in these beds.

Cross-bedding in water-laid sandstones, which I consider these to be, seems necessarily to mean either shore conditions or very shallow water. The wide extent of the beds, which cover an area of thousands of square miles, precludes shore conditions over the whole area. I assume that the known facts indicate that a broad, flat basin was occupied by a sea so shallow that steady winds blowing in any direction piled up the waters at the lee end and formed shifting sand bars at many places on which trees which had been washed from the surrounding shores lodged with rushes, reeds, and carcases of animals.

Age of Beds

The carnotite-bearing beds have in general been regarded as of La Plata (Jurassic) age. There seems, however, reason to doubt the correctness of this general designation. Field work done during the fall of 1913 indicates that the Utah deposits, at least, lie in beds of McElmo age. So far as I am aware, the only geologic work bearing upon the carnotite deposits in the Paradox Valley region, results of which have been published, was that done by F. L. Ransone and A. S. Spencer in 1899, and by them the age of the rocks in which the carnotite occurs was given tentatively as McElmo on La Sal Creek, and as La Plata on Roc Creek. On the San Rafael Swell the carnotite-bearing sandstone has been determined by C. T. Lupton as of McElmo age.

In the Henry Mountains, the La Sal Mountains, and in Dry Valley, 20 miles north of Monticello, the bed which carries the carnotite is apparently the same as that on the San Rafael Swell. At Placerville, beyond the eastern edge of the field, a little carnotite occurs as an accompaniment of vanadium-bearing sandstones which are positively known to belong to the lower part of the La Plata. It is notable that in this district

no petrified wood or other vegetable matter is associated with the carnotite, which occurs mostly as an efflorescence along joint planes in roscoelite-bearing sandstone. This carnotite has evidently been formed by the breaking down of some mineral accompanying the roscoelite. In Routt and Rio Blanco counties the carnotite-bearing sandstone has been identified by Gale as La Plata, and it seems probable that the occurrence in Eagle County may also belong to the same horizon, for the Hayden Survey Atlas shows outcrops of "Jura-Trias" ("Variegated beds") in this general locality. On Red Creek, in northeastern Utah, the occurence is wholly different. Here tyuyamunite, the calcium carnotite, occurs with more or less copper carbonate along planes in a white quartzite which may be of pre-Cambrian age.

Closely Related Deposits.

At a number of places deposits of other uranium minerals occur adjacent to the carnotite-bearing area. Near Fruita. Wayne County, Utah, a uranium sulphate is found with copper carbonates in a thin lens of sandstone in rocks which are considered by Lupton to be of Vermillion Cliff age, and to correspond to the Dolores formation (Triassic) of Colorado. Near Pahreah, close to the southern edge of the State, autunite and uranospinite are reported to occur along joint planes in a white sandstone of unknown age. In Temple Mountain, on the San Rafael Swell, uranium and vanadium minerals of uncertain composition occur in sandstones which are probably of Dolores age. The minerals from this locality are now being chemically investigated in the laboratory of the United States Geological Survey. Several other sporadic occurrences are also known.

Occurrence of the Carnotite.

In general the carnotite of the area under consideration occurs in flat lenticular deposits, only a few of which are known to reach more than 100 ft. in length and width. They are from a few inches to four or five feet in thickness, conform to the cross bedding of the sandstone and are in some places forked from following two cross-bedding planes which happen to meet in a line. The deposits of the main area are invariably connected with fossilized plant remains.

The carnotite most commonly fills spaces in the sandstone, either filling breaks in the cementing material or coating joints in the rock and the sides of cracks in fossil wood. Much of it so found appears to the unaided eye to be a powdery amorphous mass though under the microscope it shows a crystaline structure. Along some joints, especially if the carnotite is in very small quantity, the crystaline structure is evident, though the crystals are small, probably less than one fourth of a milimeter across, and are generally in radial groups. The carnotite also fills cavities in sandstone, petrified wood and carbonized rushes, and sometimes replaces wood with a comparatively solid mass. In Bull Canyon, south of Paradox Valley, a tree trunk between 50 and 100 ft. long was replaced by a mass very rich in carnotite and similar occurrences are reported from Long Park, north of Paradox Valley. In these replacements and in their occurrence with fossil vegetation the deposits greatly resemble the copper deposits in the sedimentary beds of this and adjacent regions. Schrader describes, as occurring in the Triassic "Red Beds" of northwestern New Mexico, tree trunks as large as 60 ft. long and 2½ ft. in basal diameter, which were almost completely replaced by chalcocite. Vegetable remains more or less replaced by copper sulphides, in many places altered to carbonates, are common to nearly all known copper deposits in the sedimentary rocks of the high plateau region. Carnotite is not known to occur without an accompaniment of other vanadium minerals, hydrous iron oxides, and in many places, copper and chromium minerals. In the ores mined vanadium is always in excess of the uranium. Commonly carnotite occupies the middle of a deposit and around it the sandstone is impregnated with undetermined black vanadium minerals, the calcium vanadates, hewettite and metahewettite and in places volborthite and calciovolborthite. Still farther out the sandstone is stained with iron oxide, and in some places with a green chromium mineral. Selenium has been found with the vanadium minerals at many places. It is possibly in part elemental as suggested by Dr. Hillebrand. In a very few deposits iron sulphides is found.

Where carnotite occurs in fossil wood the degree of decay seems to have largely governed the quantity of replacement. On the Amarillo claim, in the La Sal Mountains, a length of more than 20 ft. of a forked petrified tree was mined for ore, and in the tree the uranium was richest around the outer edge—the part which was evidently most decayed. Wood that shows its structure well carries little carnotite, and, except in small quantities which occupy cracks, carnotite does not accompany the carbonized wood which occurs here and there in the sandstones. In this its occurrence is also like that of copper sulphides in the sediments of the high plateaus. My examination of typical specimens in which carbonized wood is supposed to have been replaced by copper sulphides has developed the fact that the cells of the wood, at least in part, have been well preserved. In carbonized wood, however, the cells are always collapsed and have largely or wholly lost their identity. In these supposed replacements, therefore, not alone was the coal not replaced, but only that part of the wood which was not replaced by copper or other minerals has been carbonized. The same reasoning will undoubtedly apply to uranium and vanadium minerals.

Exposed ends of fossilized sticks a quarter of an inch in diameter have been found which have around them an aureole of carnotite and hydrous iron oxide 1½ in. in diameter. The sticks are now represented mostly by limonite. These occurrences illustrate vividly the migration of carnotite away from vegetable remains. a dissipation of theoxidized minerals from the original deposit which I believe to be the ordinary movement under present conditions. I observed a precisely simliar phenomenon in a copper deposit near Ouray, Utah.

The relations of the carnotite and the fossil vegetation in the sediments of the area may be summed up thus:

1. Carnotite deposits always contain fossil vegetation.

2. Spaces in the rocks, which were formerly occupied by vegetation, including large trees, are now occupied by carnotite and associated minerals.

3. The fossil wood was floated to its resting place and was not petrified until it had been buried rather deeply.

4. Neither carbonized nor silicified wood has been replaced by metallic minerals.

5. Carnotite is an oxidized mineral which may have migrated some distance from its original position. Aureoles show that under present conditions carnotite and other metallic minerals are moving away from rather than toward fossil wood.

An Ancient Gold Market.

Placeres del Oro, Guerrero, for generations has been a gold buying and selling market. As a placer gold area the locality has been a producer since time immemorial and lode mining has long been pursued by the natives of the country, who sought out the rich superficial veins and pocket gold, grinding it in arrastres and panning out the product.

Indian Miners.

No inconsiderable part of the natives about Placeres find their living, meager enough usually, in mining and milling their own gold. In the rainy season much gold is washed out by the same people, and for three of four months of the year Placeres lives up to its name as a gold washing camp. For a day's ride in any direction from Placeres the country has been combed for no one knows how many years past by the gold washers and native prospectors, many of whom are miners of considerable accurate knowledge and skill.

From time to time new deposits of placer gold are discovered, and it has been only a few years since a find was made in what is known as El Puerto del Oro, about five miles from Placeres, which was sufficiently good to make many of the Indians temporarily rich and to throw the locality into a fever of gold excitement.

Gold in the Market.

On every market day, which is Sunday, the gold buyers are on hand with their scales and silver coin ready to purchase gold at current prices, which vary greatly according to the abundance of gold offered. Clean placer gold has the preference over the mined article, as the latter is prone to retain some dirt. During the rainy season the price of the yellow metal in the plaza falls as low as five to six "reales," 62½ to 75 cents per gram. A other times, when no placer gold is to be had, the price of clean, mined gold goes as high as $1.25 per gram. The gram is the Mexican basis of computation of gold values, there being about 31½ grams to the Troy ounce.

Buyers Are Goldsmiths.

Very little of this gold goes out of the state of Guerrero, it is said, as the ore buyers are all goldsmiths who work their purchases up into jewelry, which finds a ready sale in the plazas of adjacent towns.

In few parts of the country is to be seen a display of gold ornaments equal to that shown by the inhabitants of this region. Not only do the women of the better class appear with massive necklaces of gold beads, but it is not an infrequent occurrence to see scrawny old Indian women cald in red gingham wrappers—sans shoes, sans lingerie and sans soap—bedecked with golden crucifixes and necklaces of beads which set on fire the covetousness of the curio hunter.

It is quite true that the goldsmiths mix enough copper with their gold to reduce it often below the standard fineness of the 18-karat jewelry of civilization, and insures them a better profit upon the output of their shops. For the most part, the gold is hammered or melted into massive effects. The beads are large, hollow affairs of round, oval or octagonal shapes, strung usually upon stout cords of braided thread. Very often the wearers of this jewelry have mined the gold themselves, giving perhaps forty pesos worth of gold for a necklace or other ornament which contains only one or two-thirds that value of gold and perhaps a considerable quantity of alloy.

Gold from this locality is sold in the plazas of Coyuca, Zirandaro and other neighboring towns, but Placeres is the place to which the buyers from other points come most frequently.

Mapimi Mining Camp.

One of the greatest mining camps in Mexico is the Mapimi, about six miles south of the city of Mapimi, in the state of Durango. The Mapimi mining district was discovered in the year 1598 and the mines that were first discovered were developed to a depth of 300 to 500 ft., on ore bodies only. Nothing but ore was packed to the surface on the backs of peons, and as the work pinched out from time to time work was abandoned until the Penoles Mining Company purchased the mines some 25 years ago.

The camp is reached from Bermejillo on the Mexican Central railroad over a railroad 35 kilimeters long owned and operated by the Penoles company, an English-German corporation that owns the greatest mines in the Mapimi district.

What makes this a most remarkable mining district are the large values in gold, as well as silver and lead, in the carbonates and sulphides. The gold being about one-third the total value.

The carbonate ores extend to a depth of 1800 to 2000 ft. to water level, then the sulphides come in below. The gold values in the sulphides hold out to the very lowest depths.

The mines are in La Bufa mountains which are composed of Meso-creteceous sedimentaries and later eruptives. The former is formed of clayey shales intercalated between beds of grey-blue limestone sometimes black, and the eruptive rock, which is amphibole andesite.

Mineralized Chimneys.

In the anticline into which these sedimentaries are folded occurs a complicated system of mineralized chimneys, following the course offering the least resistance to the circulating waters, and having various dimensions and forms, outcropping the different mines. Some of these mineralized chimneys are connected with empty ones called "grottos" which allow passage to the surface waters.

The most important mining operations of the district are conducted by the Penoles company which has about 150 miles of underground working and for a long time extracted from 300 to 500 tons of ore a day and paid dividends of $100,000 a month. Its principal mine is the Ojuela, which is one of the deepest mines in Mexico. The company is working five shafts, the deepest of which is upwards of 3,000 ft. The Ojuela chimney attains a diameter of 40 meters between 200 and 500 meters in depth and descends almost vertically to 650 meters. This chimney has yielded an enormous tonnage. Near it is Las Palomas chimney which at a depth of 470 meters follows a horizontal direction and immediately after descends to 600 meters, and from a depth of 500 to 600 meters its diameter changes from 30 to 40 meters.

The mother lode or vein of this mountain follows the crest of the main range for a distance of 8 miles southeast of the town of Mapimi; this mother vein at the surface is 300 to 500 ft. in width in places, and the croppings are carbonates or oxides of iron. All veins on either side pitch toward the mother vein or crest of the range. The iron croppings in this district carry little or no values at surface, until a depth of 300 to 500 ft. is reached, then the pay ore is found

in large caverns, chimneys and chutes; small seams lead from one body to another. The Penoles found but little ore at the surface. The San Juan Co., struck the first pay ore at 250 ft., but afterward raised to within a few feet of the surface on good ore. Very little ore is found on the surface in this district. The only indications are the carbonate of iron croppings, which is an indication of the values underneath. All iron croppings lead to ore at more or less depth. We have here porphyry, diorite, lime and shale. Granite will be found at depth. The mother vein was cut on the Penoles mines property about 17 years ago, and showed a width of over 300 ft. of fair grade ore. The bottom of this ore body has not been found yet, but presumably will be found when the granite is reached.

The developments the past 15 years in this district show that for each ton of ore extracted, 2 to 3 tons are placed in sight. The more the shafts, drifts and diamond drills are pushed ahead, the more new ore bodies are exposed.

Tunnel System.

The most of the exploration work in the Mapimi mines is done by tunnels and cross-cuts which connect with vertical hoisting shafts. Little timber is used owing to the character of the country rock. The underground transportation is done by steam or electrical hoisting on tracks and up vertical shafts.

The richest ore bodies are found in cross fractures, The main veins strike northwest and southeast 45° and generally pitch, if at all, towards the crest of the main range. Twenty-two distinct veins are traceable on the surface. The company is operating a 1500 ton smelter.

From Mapimi a narrow-gage railroad extends 5½ miles to the producing mines of Ojuela and San Juan.

The climate in this district is ideal. The thermometer in winter never falls below 30, or goes obave 90° in summer. The elevation of Mapimi is about 4500 ft. above sea level.

Los Pilares Orebody, Nacozari.

By Courtenay De Kalb.

A geological problem of extreme interest is presented by the splendid mine which has made the Moctezuma Copper Co., one of the great enterprises of Mexico. The property belongs to Phelps, Dodge & Co., and is situated near Nacozari, in Sonora, 75 miles south of Douglas, Arizona. Opinions are not in accord concerning the genesis of the Los Pilares orebody. Undoubtedly it is complex. No simple theory may account for it. In fact the development done despite the enormous extent of the workings, is insufficient to demonstrate the order and character of the geologic events that here occurred.

The orebody is a zone or belt surrounding a central core, elliptical in horizontal cross-section, measuring approximately 2000 ft. on the major axis by 800 on the minor. This form was suspected but not proved when S. F. Emmons made his investigation of the deposit in 1905. His observations were remarkable for their comprehensiveness, considering the brief period of time in which he had opportunity to study the mine.

S. F. Emmons's Observations.

As a point of departure it may be well to recapitulate his conclusions. He showed that there had been an epoch of dynamic movement producing fault planes, shattering the mass of Pilares mountain, accompanied or followed by the introduction of silica and metallic sulphides, cementing the shattered fragments into a breccia. Eruptive action followed, during which time diabase dikes were introduced, and these were succeeded by a dynamic movement opening new cracks through which surface waters could enter.

Mr. Emmons distinctly sets aside the probability of the existence here of a volcanic stock around the periphery of which mineralization occurred. The contrary has not yet been proved, but the general appearance today strongly favors such a conception. The mass of rock which was at once the locus and mineralizer for the orebody is probably rhyolite. Mr. Emmons tentatively classified it as a quartz monzonite, but he also called attention to the possibility of its being a highly altered and silicified variety of andesite. The rock is certainly interlaced by minute veinlets of secondary quartz, as well as being impregnated by grains of the same mineral.

The stock-like character of the mass is now strikingly apparent, but the warning of Mr. Emmons that "circular orebodies, or socalled chimneys, often result from the mineralization of a shattered area, enclosed by three or four interesting fault-planes," must be borne in mind until more detailed study of this occurrence can be made. It is unquestionably a chimney-like mass, impregnated with sulphides of iron and copper, enriched around the elliptical periphery. The interior rock-mass contains pyrite and chalcopyrite, disseminated after the manner of the sulphides in the monzonite porphyry deposit at Ely, Nevada. The entire core of silicious rock at Los Pilares will average, so far as present workings reveal its character, as much as 1 per cent. copper. This brings it within the category of the disseminated porphyry deposits. It is not now looked upon as a source of commercial ore, however, only the enriched surrounding zone, like a circular vein, which yields about 3 per cent. copper, being taken out for concentration.

This body of impregnated rhyolite porphyry spreads out upon the surface in the form of a cap. The limits have been well determined in one direction, though they remain uncertain on the opposite side. Where definite observations are possible the porphyry is seen to overlie the original andesite of the country . The cap has been deeply eroded at places, but on reconstructing its shape it appears like a mushroom, with the mineralized stock for its stem. The cap is partly overlain by andesite breccia. It may have been a laccolith, now largely exposed by denudation.

The present commercial ore in portions of the mine is sharply bounded by slip-planes, on the outer rim as pointed out by Mr. Emmons. This is not universally the case, however, on the inner boundary, the orebody quite as often possessing no limits recognizable to the eye, but gradually shades from commercial to non-commercial ore. Brecciation is persistent in the deeper levels as well as near the surface. Bornite and other secondary copper minerals were abundant in the upper part of the mine. These have practically disappeared below the 700-ft. level. The ore has become a dense fine-grained pyrite with chalcopyrite replacing the porphyry. The average composition of the output of the mine is approximately:

	Per cent.
Copper	3.00
Alumina	12.52
Silica	50.24
Iron (metallic)	14.18
Sulphur	11.04
Lime	0.47

* Abstract of an article in Mining and Scientific Press.

It is interesting to observe that despite the secondary enrichment nearer the surface, the ore in depth, which is regarded as primary, shows no appreciable diminution in copper content. It is not certain, however, that the elliptical enriched zone does not represent a concentration from the core of porphyry toward its outer edge, although the tendency to the formation of shoots of greater width and of irregular shape indicates the existence of channels which may have served for the rise of solutions from below.

The orebody in places is as much as 300 ft. wide, while the more usual width is from 50 to 150. The northwest end is the most irregular as it is also the widest portion of the mine. The alteration has been excessive at this point, and there is here an excess of water in the orebody.

Mining Methods.

The mining methods are of great interest. No attempt has been made to cave, and in only a few situations has square-setting been adopted. Less than 10 per cent of the workings is held open by square sets. The system is first of all that known in New Zealand as 'shrinkage' stoping, that is, allowing the stope to remain filled with broken ore, only the excess bulk produced by breaking being drawn off and sent to the mill. After a suitable amount of ground has been thus removed from 100 to 300 ft. high according to local conditions, the broken ore is all drawn and if ore still remains in that back, or other conditions require it, its space is filled with broken waste milled down from the surface.

The same system, however, is not employed throughout the mine, conditions necessitating various modifications. On the northeast or 'caliche' side, a stope on the 200-ft. level, 600 ft. long by 15 to 30 ft. wide, is being carried by the shrinkage system to the capping. It will be drawn empty and the capping and walls shot down to fill it. From the 600-ft. where the orebody ranges from 100 to 300 ft. wide, upward to the 200-ft, level where the orebody ranges from 300 to 100 ft. wide, stones 50 ft. wide are being carried across the strike of the deposit, leaving 50-ft. pillars between. Filling is done progressively as the stope advances so that consolidation will have occured in the 'fill' by the time the 200-ft. level is reached, when the pillars will be removed by top-slicing. The decomposed country rock makes an admirable filling, and consolidates so rapidly as to make a hard smooth floor in the stopes at once. The ore can be shoveled as readily from this newly made 'fill' floor as from boards.

In the method, now in progress on the southwest or 'Evans' side of the mine, the stopes from the 600-ft. level are carried up by successive cuts and fills. The waste is sent down rock-mills from the levels above. When the 300-ft. level is reached the surface of the fill will be left inclined. Upon this the ore above is broken, and the stope is carried upward to the caping by the shrinkage system, the excess bulk being drawn from the foot of the stope through suitable drifts and cross-cuts. Two or three pillars are left in the lower stopes to insure stability of the walls. These will not be recovered until the ground is worked to the surface. Then they will be removed by top-slicing. It will be seen that this is the direct opposite of the method used in the wider stopes where the upper levels are worked out before the stopes reach the 200-ft. level, after which the pillars are won by top-slicing.

The operation as now being conducted from the 600-ft. level on the southwest side of the mine involve mill-holes first driven 50 ft. apart. These serve for delivery of the barren rock for filling the stopes, and also for cutting points. The ore is cut in stepped slices, following the usual overhand-stoping system, the men standing on broken ore, as the cut advances, and the broken ore in turn resting on the rock-fill W W, W, below. In the beginning the length of these open stopes was limited to 150 ft., with 50-ft. pillars between, but as experience of the strength of the ore was gained the length was increased, until today no fear is entertained in leaving long stretches unsupported. The span of 75 ft. in places has proved perfectly safe, but in some stopes the conchoidal slips, evidently due to pressure resulting from expansion of volume during alteration, present enough danger to necessitate narrower arches. In a portion of the ground these slips are very numerous. It is here that square-setting is practised.

Delivery of Rock.

The fill-holes, as seen, lead directly into the stopes, but they do not extend to the surface from the stopes below the 200-ft. level. The main rock-mills for delivery of rock to lower levels terminate in bins from which the material is drawn into 20 cu. ft. cars, trains of seven being made up and drawn by 3-ton Goodwin electric locomotives to the mill-holes leading into the stopes. These holes are spaced 50 ft. apart, on the southwest side of the mine, following the strike of the deposit, and on the northeast side, where the orebody is wide, they are similarly spaced transversely, or across the deposit. The rock for filling is broken by deep shots around funnel-shaped quarries at the surface, terminating downward in large mill-holes 15 by 15 ft. in section. In these mill-holes are off-sets, each provided with a grill of iron-faced timbers spaced 18 in. apart, the rock banks at the offset, partly covering the grill. Here workmen can break the larger masses to suitable size, without being exposed to danger. The total cost of rock-fill delivered into the lower stopes and spread with an even top ready for continuance of mining, does not exceed 25c. per ton.

On the 400-ft. level where the orebody is narrow, and the shrinkage system is used, drifts 5 by 7 ft. are driven in the country rock at a distance of about 10 ft. from the vein. Cross-cuts 5 ft. wide are then driven, 15 ft. centre to centre, through which the excess bulk of ore is removed by shoveling. The walls at other places are so sound that stopes of enormous dimensions are opened, some of these being 250 ft. in height by 110 ft. in width, which stand without any filling.

In stoping, both Waugh and Shaw drills are employed. One-inch cross-steel is employed, with bits expanded to 1¼ and 2½ in. The dynamite used is 40 per cent, and the sticks are 1⅛ in. diam. These drills average a duty of 50 ft. of hole per diem, and the normal output per machine is 40 tons of ore. The length of holes drilled is from 6 to 7 ft. The cost of mining, while not definitely stated, is low, probably less than $150 per ton. Even where square sets are used the cost does not ascend to $2.50 per ton. The mill-holes are unlined, but the ore-chutes are lined with 2-in. plank. The manways are timbered with boards 2 by 12 in. diam., fitted with bevel-joints at the corners. This insures stability and safety.

The ore is assembled and dumped into chutes leading to main loading bins on the 700-ft. level. A principal gangway, or adit, traverses the central porphyry core from the portal on the northwest side of the mine, extending about S. 35° E. 5000 ft. to the main shaft, cross-cutting the elliptical orebody along its major axis. In this adit is a 36-in. gauge track, over which the ore is hauled to the portal in 25-ton steel side-dump cars, made by the Ingoldsby-Dusey Car Co., in trains of seven, by 6-ton General Electric Co.'s locomotives. The power is transmited from the central

power-station at Nacozari. The cars are then delivered to the steam-locomotives which take them to the mill down a greatly detoured railroad six miles long.

Timbers and other mine-supplies are taken by the trolley to shafts at the points of intersection of the aforementioned adit with the vein. Timber-framing, drill-sharpening, and general machine-work are all done on the surface near the shafts. Drills are sharpened by a Leyner machine, which is operated by Mexicans and Japanese. No American labor is employed aside from shift-bosses and timbermen. The Mexicans have been trained to all classes of work, which is done in accordance wtih the best methods used in the United States.

Tendency of Cyanide Mill Practice During 1914.

Never since the introduction of the cyanide process has there been so much change in practice as during the past two years. The process, which a few years ago seemed to be almost standardized, has since proved to be capable of all sorts of changes. Many of these changes will, of course, be of only a temporary nature; later experience will discard them as it has discarded so many of the so-called improvements of the past. But among the many shifts in the choice of machinery and arrangement of mills, there will be some which established and conservative metallurgists can not afford to ignore. The following summary of practice during the year, 1914, written By A. B. Parsons, a metallurgist of Salt Lake City, and which appeared in a recent issue of the Salt Lake Mining Review, gives a convenient general view of what cyanide men are doing, and the trend of practice:—

While the year just passed presents no devolopments of a radical nature in either the art or application of cyanidation, still there has been a tendency toward growth along lines of previous practice and a review of the year is not without features of possible interest. A number of new plants in Rhodesia, the Transvaal and Australia were completed and put in operation during the year, but as usual the design followed closely the so-called 'standard" practice in their localities. Nissen stamps were used in one plant in Rhodesia. In Mexico, of course, construction work was at a standstill, so that the progress was confined largely to the United States and Canada.

In spite of the apparently well founded view that the average ore from a breaker can be crushed more economically with rolls, providing they are properly handled, builders of new cyanide plants seem content to rely largely on the old gravity stamps. It is true that rolls have been adopted in some instances, as have also Chilean mills and ball-mills, but by far the majority seem stubbornly to persist in the idea that stamps are an essential feature in milling gold and silver ores. Screens with larger openings are being used, three-mesh being quite common, and in at least one case two-mesh screens are being employed. This admittedly tends to increase the efficiency as a crusher. The tendency seems to be toward stamps weighing around 1,550 pounds, compromising between the 1,050-pounders of a decade ago, and the heavier stamp of the Rand.

Tube Mills As All-Slimers.

Tube mills, under the usual modern conditions of all-sliming, are of course practically indispensible, but the dimensions seem to be almost as numerous as the number of installations. It is generally recognized that in a mill of the old proportions, 5x22 or 4x20, maximum efficiency is not even approached on account of the inability of a large proportion of the sufficiently reduced particles to escape from the tube. The present idea is to get material through the mill rapidly, classify the finished slime and regrind the oversize. With this end in view mills 5x14 have been installed with unquestioned economy of power, and still shorter lengths and greater diameters, approaching the dimensionns of the cylindrical section of the conical mill, have been tried. There is, of course, a critical length somewhere, beyond which it will not pay to shorten the tube, varying, no doubt, with the character of the ore, and conditions of feed in particular cases. The proponents of the conical mill make the significant claim that, no matter how this critical length may be, improvement may be had by supplementing the cylindrical portion with cones at each end. Chalmers and Williams adjustable quick discharge is designed to facilitiate the removal of finished particles and seems to have helped matters in some instances. At one point in Mexico experiment with a 5x14 tube resulted in a remarkable reduction in per-ton cost by simply crowding more than five times what had previously been normal feed through the mill. The conclusion was that power consumption is independent of the feed, while, up to a certain point, ultimate efficiency is proportional to the feed. In several recent plants both conical and cylindrical mills have been installed, the former as an intermediate crusher, the latter as a grinder.

Mechanical Classifiers.

Mechanical classifiers are as popular as ever and are used universally. While there are a number of installations in this country where both the mechanical and diaphram cone types are used side by side, there is scarcely an instance where the cones are used exclusively. On the other hand mechanical classifiers are gaining ground in foreign practice, a fact which is likewise true of other devices more or less American in their origin, in spite of the apparent slowness of English metallurgists in the adoption of anything new.

The Dorr machines seem to hold their own in competition with those of the spiral or screw type, although it would appear that the latter have a great mechanical advantage, with but few boxes and a positive motion, opposed to a dozen or more bearings and reciprocating action. The Dorr three-stage dewaterer and washing machine is a recent development of the classifier whose utillity is what its name implies. It separates, deslimes and washes a barren sandy product, which can at once be discarded without loss of gold or solution.

Continuous Counter Current.

The feature of progress during the year is the continued development and wider application of "continuous counter-current decantation." Whereas a year ago there were only a very few comparatively small plants making use of the plan, and its success as a substitute or alternative to filtering was strongly questioned, there are at persent numerous instances where decantation is being used exculsively and successfully with no filter whatever, and many others where filtration is preceded by some system of decantation.

The whole thing is based primarily on J. V. N. Dorr's simple contrivance, the continuous thickener. As a matter of fact the simplicity of the whole thing, in theory as well as operation, is responsible for its great success. If a tank can be fed continuously, at reasonable capacity, with eight tons of solution to one of

dry pulp and deliver a 30 or 40 per cent slime and a clear overflow (which is being accomplished in a dozen instances) it is easy to see how gold-bearing solution can be replaced by a few repetitions of the process.

The problem of displacing solution with water is complicated by the necessity of limiting the amount of fresh water introduced into the system. It is this last point, largely, which in some cases has made it advisable to include a filter in the process, although there are several instances where expensive filter plants, previously installed, have been forced into disuse. The pulp from the final thickener is often discharged with moisture as low as 30 per cent and even with 50 per cent the loss may not be excessive when the diminished value of the contained moisture is considered.

While the primary purpose of decantation is to displace valuable solution, the extraction also benefits from the incidental agitation and application of fresh solutions. It is possible to arrange any number of variations by which agitators and thickeners are put in series to best take advantage of conditions. The solution to be precipitated can be taken from any one of a variety of sources, and it is possible to obtain a comparatively small quantity of high-grade pregnant solution, with an appreciable saving of zinc.

Transfering Solution.

Experience seems to indicate that in transferring solution the air lift affords the best results, while for slime the diaphram pump appears to have given most general satisfaction, although air lifts and other types of pumps hae been used with varying success. In the diaphram pump power consumption is small, a thick pulp can be handled and maintenance is principally confined to the replacement of rubber diaphrams. These are inexpensive and if made of the best material last for several months. A simple scheme for regulating the duty of the pump is the placing of a small pet cock on the suction, which can be adjusted to provide for any required amount of pulp.

New plants where agitation is conducted by the "charge" system have been rather conspicuous by their absence, so that in the selection of agitators a very important consideration has been their performance when operated continuously in series. In spite of all arguments to the contrary it is almost out of the question to prevent an accumulation in the bottom and along the sides of a Pachuca tank, with consequent reduction in capacity, when operated continuously. In one case a Pachuca, drained after more than a year's operation, was found with 20 ft. of slime packed in the bottom, with a two-foot shaft through the mud leading to the bottom of the lift pipe. Still, in spite of this and the other recognized drawbacks, we find Pachucas being installed.

The Hendryx agitator is subject to the same criticism, only to a still greater degree. The Parral has been carefully developed and with a properly proportioned tank, and a multiplicity of transfer pipes footing in a annular V-shaped trough in the bottom, sufficient current can be set up to keep the floor "swept" clean. The Parral, also, has the advantage of dimensions more eaisly adapted to a continuous counter-current system. The Trent seems to hold its own and users, as a rule, are with difficulty persuaded to the belief that any other agitator is its superior.

The machine, however, which seems to have been selected for the majority of recent installations is the Dorr. It has the great advantage of absolutely preventing any accumulation in the bottom and in addition is simple and affords satisfactory agitation.

The Use of Filters.

In new plants where filters have been deemed necessary preference has been all in favor of the continuous revolving types. This is, no doubt, in a large measure due to the development of the decantation system, where as a result of replacement with low-grade solution in previous steps, the washing of the cake is not so essential a feature, the function of the filter being largely the dewatering of the pulp. Operators of the Oliver filters suggest a number of essential conditions, inattention to which may be the cause of indifferent results obtained by some users. Among other things the specific gravity of the pulp should be at least 1.45 and preferably higher; vacuum should be maintained at 25 inches; there should be ample agitation in the filter tank; and the wash should be applied as an atomized spray. The Portland filter shares favor with the Oliver for similar reasons. Both are practically automatic in operation and with a system of continuous agitation and decantation the cyanide end of a large plant can be looked after by a single attendant.

The Kelly Filter Press.

The Kelly filter press has been installed in several new plants and the Burt revolving pressure filter is receiving some attention. Not a great deal has been heard of the Butters and Moore vacuum types although each, of course, continues to handle immense tonnages of slime, where thorough washing is essential.

Proper clarification of pregnant solution previous to precipitation, with shavings as well as with dust, has been given closer attention. Presses of various types, leaf filters, sand filters and excelsior filters of different kinds used. One operator effects clarification by giving a bonus to his shiftmen for keeping slime out of the gold tanks, it is probable that he could get better precipitation if he had a clarifiier, too. Decanted solution generally carries fine slime, no matter how clear it is to the eye.

A recent plant in Canada has adopted a simple substitute for a press for collecting zinc dust precipitate. A long slender cotton bag of light material is incased in a slightly smaller one of heavy duck. A series of such bags are fastened to small pipe nipples on the discharge line from the precipitating pump. The inner bag does the filtering and is burned with the precipitate; the outer resists the pressure and is reused until worn out. The plan was first used some years ago in Mexico, but is novel and has manifest advantages which might recommend it for adoption elsewhere.

Precipitation with aluminum dust has lived up to every expectation and a new high-grade mill at Cobalt has been built along lines similar to the Nipissing plant using aluminum as the precipitant. An interesting item, here, is the recovery of the mercury from the residues by transferring the washed cake on the filter leaves to an additional vat, and drawing a mercury solvent through it. The mercury is then precipitated for reuse.

Refining Precipitate.

For refining precipitate either a reverberatory or blast furnace, followed in either case by cupellation, is the method in vogue in most large plants. A notable exception is the Tonopah-Belmont where a large bulk of precipitate is smelted at minmum cost, in a single operation, by means of a direct fired Monarch-Rochwell tilting furnace. At a number of small plants it has been figured economical to ship the precipitate direct to the smelters instead of refining at the mill. A possibility which has been discussed and experimented

upon to some extent is the recovery of zinc by distillation during, or just preceding, the process of melting the precipitate.

A glance into the past reveals the time, not long since, when the presence of almost anything but free gold and silicious gange was thought to preclude the possibility of successful cyanide. Through rapid stages the process was developed to beneficiate silver ores, refractory tellurides, heavy pyritic concentrates, complex sulphides of every description, arsenide ores of Cobalt and even silver-bearing speiss, a product of blast furnace smelting. What will be next?

Keeping Records of Mine Sampling.

By A. Livingstone Oke. *

The following notes and descriptions deal with methods which the writer has found effective with native assistants, on the silver and gold-silver mines of the Argentina & General Exploration Co. Ltd, situated in the province of San Juan, Argentine Republic. The methods are adapted to vein formations, the mines here presenting the usual type from the sampler's point of view.

All samples that seem to carry values are taken in duplicate, greater accuracy being obtained by this means and also an excellent check on the work. A ticket with the same number is placed in each of the two bags. A consecutive mine numbering is carried for each group, and under no circumstance is a number repeated except in the case of duplicates. These numbered series are reserved for the regular sampling, the routine five-foot section samples, to the recording of which these notes are especially devoted. All other occasional samples, such as bi-weekly face samples, grab samples of cars or dumps, etc., have a ticket designated by letter together with the date, descriptive notes, all of which is recorded in a separate note-book apart from the routine section sampling. This obviates all confusion and the use of numbers that have already been used for samples taken at another time and place.

Mine Sample Numbers.

The first record of the regular mine sampling is kept in a small note-book, an entire page being devoted to each section. At the top of the page is placed the date and the data necessary to locate the sample section. In the center is a rough sketch of the drift, or winze, with notes indicating the character of the walls and roof, the hanging and foot walls, the width over which the sample is taken, its character, etc. The position whence each sample is taken is indicated on this sketch by the numbers which accompany the sample bags.

The samples are invariably numbered and taken from left to right looking in the direction of the drivage, and also the roof samples before those in the floors. An insistence upon this rule obviates the necessity of noting in the hand-sketch which is the foot and which the hanging wall. By allowing one page to each section ample space is afforded for all necessary notes. This occasionally leads to an apparent waste of space, but it is counter-balanced by the advantage of doing the work in a definite way which admits of no variation, an important point when working with untrained native assistants.

The note-books employed underground are small and thin. The reason for this is that the sampling for only a week or so goes into one book after which it is handed into the office and filed consecutively. If small ones are used they reach the office before they are too dilapidated for filing. In underground sampling, in the dark and the damp, everything should be arranged so as to require the minimum of writing, and it is often possible to make the sketches and put in the numbers in advance of the actual work of sampling, leaving only the sample widths and other data to be noted on the spot. In this case it sometimes happens that an extra sample is required, when it at is better to repeat the nearest number, adding a distinquishing letter than to use a number which more properly belongs to a section further on. All this facilitates the subsequent writing up of the sampling in the office records, and helps to keep the numbering consecutive and in groups for each period of sampling.

In case a drill-hole is deemed necessary, the drillings of which are to form a separate sample, the fact is recorded in the mine note-book by drawing a straight line at the proper point on the section sketch, and the sample is numbered with the nearest number with the letter T attached. This letter T always indicates a drill-hole sample, and even if the sampler forgets to record it on the sketch it is alway easy by means of the system of numbering to locate it in the office The advantage of the system lies in having a definite rule for each detail of the entry on the records. Once learned these rules save a good deal of trouble in the subsequent writing up of the work. If a drill-hole sample is divided into parts, these are indicated by putting on the sample ticket the number and also the depth at the beginning and end of each part. Thus, 1147 T (0—7 in.) and 1147 T (7—20 in.) on two sample tickets mean that both these samples are from the same drill-hole and that the first indicates the first 7 in. of depth while the second represents the portion from a depth of 7 in. to 20 in.

Assay Office Records.

The samples as they come into the assay office require no further numbering until entered into the assay-office record book, when a consecutive laboratory number is put against each sample, and the same number placed on the sample sack, in case the pulp is to be preserved for future reference. This laboratory number is the one that appears on the outside of the sack, the number indicating its place in the mine sampling system being inside. This facilitates the identification of samples required for re-assay, the sacks being stored in the order of assay-office numbering and no attempt being made to separate them into classes according to their derivation whether from mine, mill or special sources. The assay-office day-book contains, in addition to its own sample number, the numbers and marks used in the mine and elsewhere, and its records are of importance only until the results are transferred to the main record. The assay-office records may be kept on a loose-leaf file, but for a day-book a special book is preferable.

After the assay results together with the corresponding numbers from the laboratory and the mine, are entered on the mine sampling record the descriptions of the samples are filled in from the sampling records. The work belongs to the duties of the survey department and should not be left to the assay-office force.

Forms for Keeping Records.

The forms used for keeping the completed records of the sampling are of two kinds, one for horizontal or inclined workings and the other for shafts and winzes, both made of rather stiff paper punched for filing in a wall file. On the form for horizontal workings the line across the top contains the names of the mine and the working, the space below divided into nine

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Mexican Scenes.

columns. The first column gives marks, locations and number of section; the second, the mine sample number; the third, indicates by letter whether from floor or roof; the fourth, the portion of the lode represented, whether foot or hanging wall side; the fifth, the assay value per short ton; the sixth, the mean assay value, all regular samples being in duplicate; the seventh, the width of samples in inches; the eighth, inches of width multiplied by ounces of value; and the ninth, remarks, in which are recorded observations of the sampler regarding character of ore, appearance, mineral composition, etc. At the bottom of the record of all samples of a given section, a line is drawn, and the results for the section summarized, mean width, mean value, etc.

The form used for shafts and winzes is similar to the one described above, except that in the third column instead of indicating the roof or floor the position of the sample in the vertical working is indicated, by letter representing east or west wall. In other respects the two forms are the same. In case it is desirable to show the content of other metals, copper or lead, etc., other columns may be added without materially modifying the system. These forms when filled may be filed in any approved way, either in wall files or in loose-leaf sectional binders. The plan followed here is to place them in a home-made wall file, one for each working, and arranged along the office wall at a convenient height for reference. There are two nails for each binder on a long strip of wood running the length of the room, the ends of the nails being bent slightly upward.

The advantages of this method of keeping sampling records are: — The most recent sampling results are always on top in easy view on each file or binder. Only as many binders are in use as there are workings being sampled. The binders never become unwieldy in size, and are much more convenient on the drafting table than any form of book could be whether loose-leaf or otherwise. When the sampling for any given working is completed it is easy to store the records, for they occupy little space and lie flat in a box or drawer. If errors occur and later corrections make any particular sheet unsightly, it can be removed, copied and replaced in a few minutes.

This arrangement with loose-leaves and section binders for each working is in effect a card index, with the added advantage that it is self indexing and includes only the work in hand at the moment. A peculiarity in the forms themselves is the method by which the total results may be shown on two lines left below the inch-ounce, or inch-value columns in each section. These totals are usually carried out on the right of the sheet, but when totalled below the column to which they belong the operation is more simple and there is less liability to error. These lines are ruled in after the record of the section is complete, for the amount of space required for each section varies with the number of samples taken. The forms also facilitate the calclation of tonnage and average values, for the total inch-value is shown for each section.

The sheet forms may be made to show every possible item of information needed, both as to distribution of the values, the credibility of individual results, samples being in duplicate, and steps by which the final value was obtained, end with a minimum of actual writing and inconvenience of entering results. The forms described are sufficiently flexible to cover all possible variations in lode formation due to enrichment in stringers on one or both walls. At the same time the inch-value for each band of the lode width is shown as well as the total for the whole section, information of prime importance when it comes to considering what portion will yield payable ore, and what part of the vein may be better broken separately as waste rock.

Honduras.

By C. F. Spaulding. *

Spanish Honduras is one of the richest mineral countries in the world, though very little is known about it, the many revolutions keeping capital out. During the Spanish occupancy something like $300,000,000 in gold was shipped to Spain. This does not take into account the gold stolen and otherwise disposed of.

The gold output has been and is now chiefly placer gold. Every little town and settlement in the interior has its placer miners who work out a few ounces, then dispose of same to merchants. They wash with bateas, pans and horn spoons, just as their fathers have done before them for generations. The miners hunt up a place that runs $30 or $35 and up per yard, sit down there with their batea and a spoon, scoop up the sand and gravel with the spoon, load it on to the batea and average an ounce of gold in two or three days. This ground if it were in the United States would cause the biggest kind of a stampede, and there is lots of it in Honduras.

The natives never have capital enough to wash on a large scale, know nothing about sluice boxes or even rockers, and as several told me, "what is the use to have the worry and care of sluices when we can get more than enough to satisfy ourselves with pans and bateas?"

You can find gold in paying quantities in practically all the rivers and streams on the east side of the mountain. There are several of the finest dredging propositions in the world to be found in Honduras, but the country as a whole is too rough and rugged for dredging, the ground carrying too many large boulders.

One great disadvantage in attempting anything here in the mining line is the lack of transportation facilities as there are no wagon roads in the interior except a couple that have been built by private capital into their mines. The only railroad is that from Puerto Cortez to Pimienta. The government is working on a survey for a railroad from Truxillo to Tegucigalpa, the capital.

As it is now, all mining machinery and supplies have to be transported on mule back or hauled on sledges by oxen. Cargo mules average five to eight leagues per day, if in good condition and no feast days happen along when every one stops work and celebrates. The average cargo is 200 lbs. and charges 40 to 50 cents silver per league. A league, except on government surveyed trails, is a variable quantity, from two to four miles, arrived at by the distance a mule will travel in an hour.

The formation of the country between Minas de Oro and Pimienta is mainly granite, and the more acid eruptives with limestone and sandstone cappings on the mountains and high ridges. On an extended trip you will see almost everything in the rock line.

The country is very hard to prospect owing to the heavy vegetable growth, it being almost impossible to get off the beaten trails. Around Santa Cruz a good deal of trap rock crops out, and the eruptive croppings are in general more basic than the surrounding country. The trap resembles very much the Michigan traps and also carries native copper. I saw in one place a stone fence approximately a half mile long built from this trap, and in a number of places you could see the copper sticking out of the rock.

Near Santa Cruz a native showed me a piece of pure stibnite that would easily weigh 100 lbs. He said that he picked it up on a side hill and that there was a large space covered with the same mineral. This and

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the copper would be very valuable deposits if there were transportation facilities. At present these deposits are inaccessible and practically of no value.

A hard thing for an American in the interior is the grub question. The natives exist on tortillas and frijoles and occasionally an egg or a piece of meat.

The tortillas are made by boiling corn in a large kettle with wood ashes and lime, grinding the boiled corn on a flat stone to a paste, moistening with a little water, flattening into a round cake 5 to 6 ins. in diameter and ¼ in. thick, and finally frying on a piece of sheet iron. Nothing is added in the shape of baking powder to make the corn cakes light, and not even a pinch of salt is used to give them a flavor. This food, however, is nourishing, but mighty hard to get accustomed to as it is tasteless.

The frijoles are red beans boiled for a cuple of hours. Sometimes they are mashed and fried with a little lard; then they are pretty good. A continuous diet of frijoles and tortillas three times a day, day in and day out gets pretty tiresome. Anything else in the eating line has to be packed in from the coast.

We have Wagner's principles for the "simple life" beaten to a standstill down here. Plates, knives and forks are unknown on the trail. You go into a native house for a meal, they bring in the tortillas and frijoles on banana leaves. You help yourself to a tortillo for a plate, scrape onto it some frijoles, then eat plate and all. This is very handy as it saves dish washing.

The houses seldom have more than one room. When you get ready to retire you select a couple of rafters, sling up your hammock and turn in all standing, taking care to hang up your boots, otherwise the pigs and goats will eat them up before morning.

The whole family, including the live stock, occupy the same room with you, and as they close all doors and windows the atmosphere before morning is very close, especially if there happens to be a pack train stopping at the same house as they always bring in the pack saddles, otherwise the saddles, which are built of bundles of rushes, would be eaten up before morning. When these saddles have been in use for several weeks on a sore backed mule and have gotten thoroughly soaked with pus and matter from the sores, the odor can be imagined but not described.

The native beds are made by stitching a green cowhide over a wooden frame. When that dries it gets as stiff and hard as a board, and as they don't use springs and mattresses it is a very comfortable (?) affair to sleep on. Glass windows are rare; you never see them in the interior and very seldom in the large towns; wooden shutters take their place, and bugs and all kinds of insects have full sway.

Honduras is a wonderfully rich country in minerals, tropical fruits and woods. If better known it would be opened up pretty quickly. Here is an excellent chance for the investment of capital. If you don't like mining, try planting bananas, coffee, rubber, or valuable woods, such as mahogany, rosewood, etc., or what would be a real good thing is the pine.

Few people in the United States know that there are numerous pine tracts in the interior which can be gotten hold of very cheaply.

The Mineral Resouces of Bolivia.

During the past few years the investment of North American capital in the Pacific coast republics of South American has been of large extent and constantly increasing in volume, but although the countries directly bordering on the Pacific coast have been the seat of operations by large capitalistic groups, nowhere has more interest been developed in the establishment of new mining enterprises than in the republic of Bolivia says H. A. Horsfall in Mining Science. The causes for this rapid increase of sentiment favorable to the investment of foreign capital are of easy determination. First the political quietude, including the absence of periodical revolutions, which has existed for many years; second, liberal laws that make for the security of investments by foreigners; and, thirdly ,the rapid increase of railroad and other transportation facilities within the past few years. The opening of the Panama canal, which will soon be accomplished, will afford increased and more rapid means of communication both of mail and freight, thereby bringing the United States and Bolivia into much closer mercantile relations than formerly.

The limits of the present article will not permit of an extensive description of the various railroad lines now in operation or under construction. At the present time three trunk lines connect the principal city of Bolivia, La Paz, with the ports on the Pacific coast, viz: from Mollendo, Peru, via Lake Titicaca; from Arica and from Antofagasta, Chile, About fifty miles of construction remain to be completed to unite the railroad systems of Bolivia and Argentina. A new railroad is projected north from La Paz, to the head of navigation on the Beni river, which, when completed, will give water transportation through Brazil by the Amazon river to the Atlantic Ocean.

Although Bolivia has no seacoast, having as a result of internecene wars, some years ago, been obliged to relinquish to Chile her former seacoast province of Antofagasta, yet despite the loss of this rich mineral district, she still retains within her borders extremely rich and extensive mineral deposits, containing gold, silver, copper, tin and other valuable metals.

Bolivia during Spanish colonial times was a portion of the Viceroyalty of Peru, and was known as Upper Peru or province of Charcas; since 1828 is has, however, been a separate republic of South America.

In the northwestern part of the republic is situate the largest fresh water lake on the continent of South America; it is named Lake Titicaca. It lies partly in the adjacent republic of Peru, the dividing line between the two countries passing at about the center of the lake, which has an altitude of 12,500 feet above the level of the sea. To the south of Lake Titicaca lies the extensive tableland of Bolivia, having an area of some 40,000 square miles and an altitude of 12,000 to 13,000 feet above sea level, with a bleak and cold climate. Vegetation is almost entirely absent on this table land or mesa, and water is obtained only at long intervals. This region, however, contains very rich mineral deposits.

The main ranges or "cordilleras" of the Andes mountains are here separated by a wide interval into two parts. The eastern branch, being known as the Cordillera Real, contains a succession of very lofty peaks, which, commencing in the northern part of Bolivia, are named Sorata. Ilimini, Huaina-Potosi, and numerous others, which rear their snow-clad summits far into the encircling clouds; attaining altitudes of more than 21,000 feet above the level of the sea. The most famous silver mines the world of civilization has ever known are situated in this range, in the mountain known as Cerro de Potosi, often called the Silver Peak. Discovered in 1545 and worked continuously since that period, these lodes or veins have produced an almost incredible amount of silver so that for some 300 years they practically controlled the silver markets of the world and, according to some authorities, the value of the silver produced has exceeded $2,000,000,000. Of late years the production has been constantly declining and does not now exceed $30,000 per annum. The lodes are extremely rich and extend in every

direction, and are said to be pierced with 5,000 openings; many of these are now closed and inaccessible, being filled with water and debris from former working and practically abandoned.

The city of Potosi has an altitude of 13,125 feet above sea level, the population at present is estimated to be about 23,000. This is one of the most elevated abodes of man on the southern continent, as well as in the world. Formerly the city had a population of from 100,000 to 160,000, varying from time to time with the production of the mines. At the time of its prosperity a mint and many handsome public buildings were constructed, many of which have since fallen to decay. However, in 1912, it obtained railway connection with the outside world by means of a branch line to Rio Mulato, 106 miles distant, a station on the main line the Antofagasta & Bolivia railway. A modern water supply system is being installed to replace the ancient canal system used to supply the city from artificial lakes constructed on the mountains sides.

The mountains or "cerro" of Potosi rises some 2,000 feet higher than the level of the city, and is interlaced with numerous veins containing tin ore, many of which are now being worked. Increasing prosperity is predicted for the district.

The most productive silver deposits now being worked in the republic are situated at Huanchaca, elevation 13,500 feet, reached by a branch of the Antofagasta railway from Uyuni. Until recent years this was an obscure hamlet lying south of the city of Oruro. It is the center of a rich mining district, overlooking the saline plains.

At the present time this district yields a greater quantity of silver than all the rest of the republic.

In former times there were many other silver producing districts scattered over the southern and western portions of the republic but owing to the decline in the value of silver, during recent years, most of the mines have been abandoned or are being exploited for tin.

In the early days of the Spanish occupation gold was very abundant, particularly in placers . Those situated in the high mountains lying to the east of Lake Titicaca were the most productive, but having been worked previously for centuries by the native inhabitants, and subsequently by the Spaniards, their output at the present time is very small. However, during the last few years, they have been under examination by various foreign companies, chiefly American and English Some of them are now being worked by hydraulic sluices or dredges.

Lode or vein mining for gold is now carried on in a small way, in the province of Tarija and elsewhere, but, owing to difficulties of transportation and the absence of fuel, the gold production of the entire republic is estimated at not to exceed 17,500 ounces per annum at the present time.

The principal part of the copper produced in Bolivia comes from the district of Corocoro, situated on the tableland.

At this place two large companies are operating and reducing the ore in mills to "barilla" (concetnrates), in which form it is shipped mainly to France. The production of the two companies in 1912 amounted to 4,626 metric tons of "barilla" carrying 85 to 88 per cent metallic copper. The mines are connected by a branch five and one-quarter miles in length to the main line of the Arica & La Paz railway and so connected to the Pacific port of Arica. Formerly the product was transported in ox-carts over rough trails passing through the Chilean desert to the port of Antofagasta. The deposits of copper ore in the Corocoro district are said to resemble those of the Lake Superior region—only, however, in that copper is found native in the ore and more rarely native silver is mixed with it.

Other districts producing copper ore, but at present on a much smaller scale, are Pulacayo, Machacamarca, Potosi, Chorolque, Chacarilla, La Paz and others; in fact the ores of this metal are widely distributed and only require the attention of capitalist to develop production on a large and increasing scale.

One-quarter of the total world's tin supply is produced from Bolivian tin mines. Tin oxide, or cassiterite, the ore from which metallic tin is obtained, has a very limited distribution over the surface of the earth. Bolivia, however, is very liberally supplied with lodes or veins of ore containing this useful and valuable metal. In fact, the price obtainable in the markets of the world for this metal is that which mainly governs the quantity of production.

Owing to the scarcity of fuel on the elevated table land of Bolivia, but a small portion of the ore is reduced to bar tin and that mostly in the Potosi district. At all the other mining districst the ore is merely pulverized and the tin values are saved by concentration. These concentrates are locally known as "barilla." They contain about 60 per cent of metallic tin, are the form in which the product is exported. It is well to state, however, that, owing to the antiquated methods of concentration now in use at most of the mills, large quantities of the valuable tin oxide are lost the tailings.

Most of the tin mines of the republic of Bolivia are as yet in what might be classed as virgin territory, and are principally situated in four districts, viz:

La Paz on the north, Oruro in the center, Chorolque on the south, and Potosi on the east. The districts of Oruro and Chorolque are the present time the most important producers.

The city of Oruro, population 20,670, elevation 11,720 feet, is the chief gathering point and market for the various products of the mines, including those of Chorolque and neighboring districts, both north and south. Many of the present tin mines were originally known and worked as silver mines and still produce this metal in considerable quantity. El Socavon, de la Virgin, San Jose, Huanuni, Negro Pabellon, Morocala and Antequera mines at present very rich in tin, in colonial times were considered and worked as silver mines, the price of tin during that epoch being so low that mines were scarcely ever worked for that metal.

The San Jose mine is situated about two miles from Oruro, and produces ores of both lead and tin, but at the present time tin ore is the most sought for.

The Antequera mine is situated near Poopo, on the line of the Antofagasta & Bolivia railway. It is said that the Huanuni mine contains the largest deposit of tin ore in the Oruro district. These mines are situated about fifteen miles from Machacamarca station on the before mentioned railway. The mountain in which the Huanuni mines are located has an elevation of 16,000 feet, and is in the form of an obtuse cone. The mountain is traversed by many lodes or veins, having numerous branches, some of which are being worked on an extensive scale. In the year 1905 the Cataricagua vein alone produced 1,192 metric tons of mineral. The veins and stringers are from two to eight feet in width and contain from 20 to 50 per cent of casiterite.

The mines of Negro Pabellon, Morococala and Villacollo are situated ten miles south of Huanuni, near Paria. The principal vein of the Negro Pabellon is three feet in width and crosses several minor veins. At the junctions of the veins large and rich deposits of cassiterite are generally found. The resulting concentrates ("barilla") obtained from the ores of this mine are extraordinarily rich and contain more than 70 per cent of metallic tin, being a higher grade, of concentrates than other mines produce.

In the Morococala mine the vein is from 12 to 15 feet in width, the ore being of good quality.

The ore mined in the Berenguela mine, situated in the province of Cochabamba, is of a very high grade. This mine during Spanish colonial period was noted for its very rich silver ore.

The resentative mines of tin in the central part of Bolivia are contained in two groups, that is to say: Huaina Potosi and Milluni, located to the north of the city of La Paz, and in the Inquisivi region, on the easterly border of the great tableland, between Lake Titicaca and the high mountains of the Cordillera Real. In the Inquisivi district are situated the well known tin properties of Quimsa Cruz, Arara, and Santa Vela Cruz.

The first mentioned is situated near the southeastern extension of Lake Titicaca, at an altitude of 13,000 feet above sea level: the others nearer the higher mountains. During the Spanish colonial times, these mines, as well as numerous others in this neighborhood, were worked for their silver content, but at the present time the principal mines are being worked for their tin values only. The small tin mining properties are numerous in this district, but the principal and larger part of the production comes from the mines operated by a French company, who own and work the celebrated mines of "Carmen de Huaina-Potosi" and "Milluni."

The district of Tres Cruces de Inquisives is one of the most promising in the republic, being situated in the center of the grand chain of the Andes mountains, known as the Cordillera Real, the elevations of whose peaks at this point attain an altitude of over 17,000 fet above the sea level. This region lies between and at about the same distance from the cities of La Paz and Oruro, but the communications with Oruro are much superior. The most important mines of this district are located on the western slopes of the Cerro Altarani, the group being known as the Monte Blanco owned by a Chilean company, whose principal works are situated at an elevation of 14,800 feet above sea level. One of the veins now being worked is, however, situated some 1,500 feet higher on the mountain. Among the several veins owned and worked by the company is the Santa Fe. This has been opened up for over 1,000 feet on the length of the vein and has a width of from six to nine feet. The ore averages 12 per cent cassiterite but pockets are common, which are of great extent, and the ore is nearly pure. In the immediate neighborhood are situated the Barosso Cota, Santa Rosa, La Florencia, Copacablanca and numerous other mines.

The Santa Vera Cruz is situated about 20 miles south of Monte Blanco. It is the most important mine owned by the Concordia Tin company, an English concern. The altitude is considerably less than at Monte Blanco but the methods of working are more modern, for which reason it is expected that the mine will develop into a very large producer.

What is known as the Sayaquiri district, still south of the Santa Vera Curz, is being actively prospected. Late reports are that important developments may be expected in the near future. Also the Colquiri mine formerly worked for silver is at present being developed for the production of tin ore.

The Chorolque district is situated half way between Uyuni and Tupiza, in the southern part of the republic, and some distance from other centers of production. The surrounding country is mountainous, rough and bleak, and the trails are rough and circuitous but well maintaned. A railway is being constructed between Uyuni and Tupiza which will ultimately be connected with the railway system of Argentina, and be of great benefit to the mines of this section.

Chorolque mountain is about 18,000 feet high and tin ore is found on various sides of it. The principal mines are the Chorolque, Tasna and Chocaya. The annual output is over 4,000 metric tons of 60 per cent concentrate. The ore is very rich and a modern plant has been erected. The property belongs to Aramayo, Francke & Company ,and the operations are said to yield large profits. The veins contain clean tin ore which requires no roasting. In many parts of the district, however, sulphides of various metals are found, some of them containing silver, but so refractory that their metallurgy is difficult under present restrictions as to transportation and fuel, which is a scarce commodity in the district.

The production of bismuth is quite an important industry in Bolivia. It is usually obtained in conjunction with other metals, from which its separation is easly affected. It is found in the mineral zone between Huaina-Potosi, in La Paz, in Potosi and Chorolque. The principal region is that of Tazna. It is exported in bars and the yearly production amounts to about 500 metric tons.

Antimony, tungsten and magnetic iron ore are found in several parts of the republic, considerable quantities of each being exported, as are also lead and zinc ores. Mercury is obtained from some small mines situated near the southeastern shore of Lake Titicaca, but the present production is not large.

There are several localities in which veins of coal have been discovered, but few of the deposits have as yet been developed sufficiently to determine their commercial possibilities. One of the most promising deposits is situated in the Copcabana peninsular of Lake Titicaca. This is now being developed, and official estimates by the goverment engineers estimate the deposits as being of sufficient extent to be capable of yielding 40,000 tons annually.

Petroleum is being actively sought for and a number of wells have been drilled in several parts of the republic, but no reliable reports have as yet been received. It is well known that many seepages occur, and oil has been found covering the surface of the water in natural springs, from which it has been obtained in small quantities.

There are extensive salt deposits and other mineral deposits of a similar nature, but up to the present time they have not been exploited commercially owing to the lack of transportation and the scarcity of fuel supplies.

The "permissible" explosives used in the coal mines of Illinois may be divided into four classes according to their chief component: Ammonium nitrate, hidrated, organic nitrate other than nitroglycerin, and nitroglycerin. In Illinois only the nitroglycerin powders are used besides black powder which is not classed with the permissibles. The nitroglycerin powders used contain free water or an excess of carbon for the reduction of flame temperature and usually contain salts that decrease their strength and shattering effect. They detonate easily and are little affected by moisture. In one mine a test showed that 25 lb. of permissible broke 180 tons of coal and black powder to the same amount only 91 tons. The flame of black powder extends more than three times as far as the flame from a shot of permissible explosive. In order to ignite inflammable gas and dust mixtures a high temperature acting through a certain length of time is necessary. The flame temperature of all explosives are higher than is necessary to ignite these explosives mixtures, and the flame of black powder is much longer than the minimum for ignition. The flame of permissible explosives in proper charges properly detonated is of such short duration that it does not ignite these mixtures.

PATIO.

The Rand mines in South Africa have in 27 years produced about $2,000,000,000 in gold and it is estimated that the district will produce at least as much more before the limits of economic mining have been reached. The outcrop has been traced for a distance of 55 miles.

The trial of a Knudsen furnace at the Canadian Copper Co's plant recently indicated conditions under which this furnace would have distinct advantages as compared with the blast furnace. This furnace is something like a large basic converter. The smelting operation is started with an admixture of coal and coke. Sulphide ore is used and the blowing is continued until smelting is complete, when the furnace is tilted and the slag poured off. Blowing may be continued to bessemerize the matte, after which the matte is also poured.

The Cottrell process for the condensation of fume is in successful operation at Trail, Canada. The plant makes use of of 12-in. pipes, 384 in number and 16 ft. long. These are placed in a vertical position and have a capacity of 100,000 cu. ft. per minute. The inner wall of each tube forms an electrode, and a wire passing through the center of each tube forms the other electrode. Between these electrodes a current of 75,000 volts is passed, which precipitates the dust out of the gases. The dust recovered at Trail carries 70 per cent. lead. In the installation at the Garfield smelter, Utah, 5-in pipes are used to handle converter gases. Experiments at the Anaconda plant, Montana, with 36-in. pipes to treat arsenic-bearing gases are reported to have given satisfactory results. The cost of installation is said to be much lower than that of the bag-house and operating expenses are low.

At the Vulcan iron mine, in Michigan, permanent concrete tanks have been installed for measuring, the flow of water from mine pumps. The tanks are rectangular and have a circular opening on one side for discharge, this opening being provided with sharp steel edges. Midway between the side having the discarge opening and the opposite side where the water enters there is a perforated wooden diaphragm which breaks up eddies and currents. The flow of the liquid through the discharge opening depends upon the head in the tank. The head is recorded on a recording water-level guage and tables have been calcuated to show the number of gallons per minute for each tenth foot head.

A counterbalanced hoist recently designed for one of the iron mines in Michigan has in place of two conical drums a nearly cylindrical drum and a reel for a flat rope which carries the counterweight. This method of counterbalancing can be used for a depth of at least 3000 ft. in a vertical shaft with a load of 12,000 pounds.

The use of counterweights with independent skips and cages not only reduces the total work of the hoist but makes the work, after the moving parts are up to speed, equal throughout the whole of the travel. In hoisting with skips in balance, unless a tail rope is used, the the weight of one of the ropes is added to the starting torque. This additional weight is balanced half way up and thereafter is more than counterbalanced by the weight of the other rope.

A hoist at Brier Hill in three years and seven months hoisted 500,000 tons of ore without renewal of frictions. The Curry hoist hoisted 150,000 tons in 20 months also without requiring the replacement of frictions. In a capacity test recently made with the Curry hoist 13 skips, or approximately 78 tons, of ore were raised 1410 ft. in 61 minutes. This is equivalent to 325,000 to 350,000 tons a year.

The varying demand for air is readily met with steam compressors by varying the speed, but with constant-speed motor-driven compressors some means must be used to reduce the quantity of air compressed and the amount of power required. This requirement is met by the manufacturers by means of various types of "unloaders." One of the more successful is the choking inlet controller with oil dash-pots.

Electric hoists are frequently designed to use a fly-wheel to equalize the work of the motor. It has recently been pointed out that the only advantage of the fly-wheel in connection with an induction motor hoist is to flatten out the starting peak. The actual power required in kilowatt hours will be more than when no fly-wheel is used.

It has been shown that the air in mines may become viatited with carbon dioxide gas due to the oxidation of timbers in contact with the air. That wood does combine with oxigen at ordinary temperatures was shown in an experiment conducted at the Pittsburgh station of the U. S. Bureau of Mines. Sawdust was placed in a tightly sealed bottle. After standing some time the sawdust had absorbed all the oxygen in the air in the bottle. Experiments are now being carried on to determine whether preservatives applied to timbers will reduce the production of carbon dioxide.

Only a few years ago none but the natural cyaniding ores were considered fit for the cyanide process. The original "cyaniding ore" was practically free from everything except a clean quartz gangue and free gold. Now the process is used for treating silver ores, refractory tellurides, heavy pyrite concentrates, complex sulphides of nearly every description, arsenide ores of Cobalt and even silver-bearing speiss, a product of blast-furnace smelting.

New Publications.

Ore Deposits in Custer County, Idaho. By J. B. Umpleby. Bulletin U. S. Geol. Survey, No. 539. 104 pages, 10 plates, 4 text figures.

A Geologic Reconnaissance of the Circle Quadrangle, Alaska. By L. M. Prindle. Bulletin, U. S. Geol. Survey No. 538.

Useful Minerals of the United States. By Samuel Sanford and R. W. Stone. Bulletin U. S. Geol. Survey No. 585. An alphabetical list of minerals, giving localities at which the minerals occur in sufficient quantity to be of present or possibly future value, with a glossary showing definitely what is meant by the terms used in the text of the bulletin.

Contributions to Economic Geology. Marius Campbell, in charge. Bulletin No. 531, U. S. Geol. Survey.

On the Origin of Graphite. By John Stansfield. Trans. Canadian Mining Institute. pp 401-411. Briefly outlines the several classes of graphite deposits.

The Useful Minerals and Rare Ores. By Alexander McLeod. John Wiley and Sons, New York, 1914.

This pocket manual of 114 pages is an attempt, more nearly successful than any with which the reviewer is acquainted, "to furnish severely simple but fully dependable, means by which any one can determine the useful minerals." The outfit required is fully described and includes only six reagents, a hammer, pocket lens, small magnet, a small iron mortar, two roasting spoons and deep and shallow crucibles. Directions are given for making the roasting spoons and crucibles. The determinative tables which comprise most of the volume are adapted to this small outfit and include 20 elements and about 100 minerals. The minerals are arranged in 11 groups each of which is defined by one or more simple tests.

The book is written primarily for the prospector and most of the tests are such as can be made on a camp fire. A blast lamp and blowpipe would add to the value of the equipment, but as simplicity and lightness of outfit are desired, these are not included, and the many tests dependent upon them are omitted

The section on the rare ores contains much information of more than passing interest and will be particularly valuable to the prospector searching for these metals. Simple tests for each of the rare ores are given.

It is believed that the book meets a real need of the prospector and that it will be of value to anyone in the field who finds it impracticable to carry a standard blowpipe outfit and larger manual.

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ASK FOR CATALOGUE.

Design of Steam Boilers and Pressure Engines. By George B. Haven and George W. Swett. 416 pages, 6x9, 196 figures. Cloth. Published by John Wiley & Sons New York. Price $2.00.

The Glacier National Park: A Popular Guide to its Geology and Scenery, by M. R. Campbell, is the title of Bulletin No. 600 of the U. S. Geological Survey. 54 pages, 13 plates, 13 text figures. Describes briefly the geology and scenery of the Glacier National Park, which was set apart by act of Congress in 1910, and includes that part of the Front Range of the Rocky Mountains lying just south of the Canadian line in Teton and Flathead counties, Mont. Illustrated by a topographic map of the park, diagrams showing geologic features, and halftone plates depicting some of the wonderful scenery to be found and enjoyed there.

Engineering Office Systems and Methods. By John P. Davies. 554 pages 6x9, 243 illustrations. A. practical book devoted to the systems and methods of the modern engineering office. Chapter Headings: I.—Collection of Preliminary Data for Engineering Projects. II.—Designing and Drafting Systems. III.—Specifications for Engineering Material. IV.—Reminders for Obtaining Quotations on Standard Material. V.—Purchasing-office Methods and Forms. VI.—Cost Keeping and Estimating. VII.—Sampling, Inspecting and Testing Engineering Material. VIII.—Domestic Shipping. IX.—Export Shipping. X.—Progress Charts, Scheduling Systems, etc. XI.—Indexing and Filing Systems, etc., for the Engineering Office. XII.—Drawing-Office System and Methods. XIII.—Miscellaneous. Published by McGraw-Hill Book Co., New York. Price $5.00.

Valve Gears. By Charles H. Fessenden, Assistant Professor of Mechanical Engineering of the University of Michigan. 170 pages, 6x9, illustrated. Price $2.00 U. S. C. This book covers the best known and most reputable types of steam engine valve gears. Published by McGraw-Hill Book Co., New York.

PERSONALS.

R. M. Raymond is in New York.

John H. Banks, formerly of the firm of Ricketts & Banks, is now located at 61 Broadway, New York City, where he will continue to devote himself to mining, metallurgical and chemical work in which he has been engaged continuously for the past thirty years.

J. D. Champaigne and J. A. McGowan, of El Oro, were in Mexico City the first of this month.

Bond Coleman, recently of El Oro, has gone to Seattle, Wash.

W. E. Simpson left recently for the States.

J. V. Burns, of Guanajuato, was a Mexico City visitor recently.

J. W. Wiley, of Pachuca, is in the States.

W. E. Phillips, of the Dos Estrellas company, El Oro, was in Mexico City recently.

E. P. C. Sullivan, assistant superintendent of the Dos Estrellas company, El Oro, has gone to England.

C. R. Olson is now with the Pittsburgh-Dolores Mining Co., Rockland, via Yerington, Nevada, as mill superintendent.

Glenn Anderson has gone to the States.

P. W. Avery, of the Esperanza company, was here from El Oro, this month.

S. B. Lewis narrowly escaped a serious case of pneumonia, has fully recovered and left for a trip to Zacualpam, Mex., to inspect the Chontalpam property, of which he is general manager.

Martin J. Nesbitt, of Barranca del Cobre, Chih., was in Mexico City last month.

C. A. Lantz, of the Santa Gertrudis company, will leave New York for Mexixo on June 10.

Frank H. Sistermans has returned to New York from a professional trip to Nicaragua, after an absence of over two months, and is again with the Mines Management Co., at 60 Broadway.

S. Duncan Ellis, engineer on the staff of the Braden Copper Co., Rancagua Chile, has gone to England to enlist for active service in the British army.

W. W. Stenning has succeeded E. T. Stannard as mill superintendent of the Braden Copper Co.

E. T. Stannard, recently with the Braden Copper Co., is now with the Kennecott Mines Co., operating the Bonanza and other Guggenheim properties in the Copper river basin of Alaska. His address is care of the company at 265 Broadway, New York.

O. M. Lewyn succeeds Robert Marsh, Jr., as superintendent of mines for the Braden Copper Co. His headquarters are at El Teniente mine, La Junta, Rancagua, Chile.

Pope Yeatman, consulting engineer for the Chile Copper Co., has returned to New York from South America.

Charles Reiniger, of Van Wert, Ohio, is in Sonora inspecting his mining property.

Robert Mitchell, manager of La Cobriza Mining Company's mines and smelter at La Cobriza, Sonora, recently visited the property. The new smelter expected to be in operation within ten days.

J. C., Smith is with the Elisa Mining company, at Ocoroni, Sinaloa.

John P. Cosgro, former manager of the Mexico Mine & Smelter Supply Co., now with the Allis-Chalmers company in Chile, is in London.

Allan B. Calhoun is with the Mines Company of America, located at 711 Mills Bldg., El Paso, Texas.

J. J. Hasbrouck, formerly with the Cananea Consolidated Copper Co., has been appointed engineer of the Peruvian Expedition, which left New Kork for Peru under the joint auspices of Yale University and the National Geographic Society.

TRADE NOTES

The Dorr Cyanide Machinery Co., announce that after May 1st., 1915, the address of their New York office will be Room 2843 Bldg., instead of 30 Church Street, as heretofere.

The Colorado Iron Works Company announces the establishment of a downtown office in Denver for the accomodation of its many customers and friends who may find it inconvenient to visit the main office at the works. Suitable quarters have been obtained in the Ideal building, corner of 17th and Champa streets, the most central and accessible part of Denver's business district, where the mining fraternity is invited to call when the opportunity offers. The office is in charge of Mr. Hugh B. Lowden, secretary of the company, and Mr. Randall P. Akins, sales manager, will make it his headquarters when in the city.

El Arco Mines has purchased from Chalmers & Williams an adjustable quick discharge tube mill, togther with Nissen stamps and other equipment for its new crushing and concentrating plant. The Cia. Ingeniera, Importador y Contratista represent Chalmers & Williams in Mexico.

Eduardo De A. Braga, who has been in the United States as special commercial agent for the government of Brazil for more than a year past, has returned to that country. He is to represent the United States Purchasing Corporation with headquarters in Rio de Janeiro.

President Copeland, of the Sullivan Machinery Co., Chicago, is quoted as stating: "The situation is commencing to show improvement in our line and in others as well. America has an opotunity to get foreign business, especially in South America, and regardless of the outcome of the war, to hold it. I do not look for any boom in business, but I do believe a gradual and steady advance in general business will be ours for the next few years."

It is reported from Rio de Janeiro that vessels have been chartered to transport about 10,000 tons of manganese ore from Brazil to Baltimore, at the rate of $6 a ton. These shipments will be made against contracts for ore which steel companies in the United States placed with Brazilian mines several months ago or shortly after the outbreak of the war. It is apparent, however, that some Brazilian manganese ore still can be obtained. A lot of 5,000 to 10,000 tons recently has been offered in New York but at a high figure.

Koering Cyanide Co., Detroit, Mich., has issuod an eight page booklet descriptive of the methods of operating the present cyanide plants in comparison with the Koering gold and silver process. Claims for the Koering process are: Separation of sands and slimes are eliminated. High percentage of extraction. No division of pulp solution. Perfect lixiviation. Washing simple.

Jeffrey Mfg. Co., Columbus, Ohio. Bulletin No. 167, 28 pages, recently issued by this company describes the Century belt conveyors and illustrates their application. Bulletin No. 143, 20 pages, lists and illustrates various styles of steel and malleable iron elevator buckets

Busch-Sulzer Bros. Diesel Engine Co., St Louis, Mo., has issued a 16 page, illustrated, booklet describing its type B. Diesel engine. It is claimed for this machine that it economizes space, fuel and attendence, start at any time, at a moment's notice, and will assume load immediately.

An interesting feature of the Type "B" engine is that it is controlled by a sensitve governor, so arranged as to keep the suction valves of the fuel pump open over a greater or less part of the working stroke of the fuel-pump plungers —a method of regulation which has become universally adopted throughout Europe. The photogravure illustrations add to the attractiveness of this publication.

Practical Irrigation & Pumping, water requirements, methods of irrigation and analyses of cost and profit. By Burton P. Fleming, Head of Department of Mechanical Engineering, State University of Iowa. 226 pages, 5¼x8, 38 figures, 27 diagrams. Cloth. John Wiley & Sons, New York, Publishers. Price $2.00.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59.207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58.175	28.038	27.825	26.704
June	61.290	59.990	58.471	28.215	27.199	26.948
July	90.954	59.721	54.979	27.919	27.074	25.219
August	91.906	59.293	54.344	29.375	27.335	25.979
September	93.079	90.940	53.290	29.099	27.996	24.290
October	93.471	90.793	50.654	29.299	28.093	23.199
November	92.792	59.995	49.092	29.012	27.293	22.703
December	93.395	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.950	15.977	19.951
April	4.381	3.910	4.242	3.693	17.597	19.225
May	4.342	3.900	4.226	3.963	18.923	18.503
June	4.325	3.900	4.190	3.910	20.229	19.411
July	4.353	3.991	4.223	3.739	20.039	19.051
August	4.624	3.975	4.550	3.715	20.409	
September	4.699	3.928	4.579	3.659	20.649	
October	4.402	3.529	4.253	3.394	20.302	
November	4.293	3.693	4.146	3.595	19.334	19.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14.672	61.603	14.971	.....	97.140	66.274
July	14.190	13.223	14.593	.....	64.166	64.955
August	15.400	.....	15.904	.....	69.200	53.227
September	18.329	.....	19.799	.....	73.125	.....
October	19.337	.....	19.913	.....	73.393	.....
November	15.182	11.739	19.022	.....	69.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1931	1914
January	6.931	5.262	6.854	5.112	26.114 25.338	21.583
February	6.239	5.377	6.089	5.227	24.605	21.413
March	6.078	5.220	5.926	5.100	27.313	21.460
April	5.641	5.113	5.491	4.963	24.583	21.569
May	5.406	5.074	5.256	4.924	22.143	21.393
June	5.124	5.000	4.974	4.850	20.592	21.345
July	5.279	4.920	5.129	4.770	20.709	21.569
August	5.659	5.599	5.509	5.419	21.149	
September	5.694	5.390	5.444	4.230	20.914	
October	5.340	4.909	5.199	4.750	20.591	
November	5.229	5.112	5.093	4.982	21.214	25.019
December	5.156		.004			
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

TIN

Month	New York		London	
	1913	1914	1913	1914
January	50.298	37.779	238 273	171.905
February	48.766	39 830	220.140	181.555
March	46.832	38.038	213.615	173.919
April	49.115	36.154	224.159	193 993
May	49.038	33.360	224.143	150 702
June	44.820	30 577	207.208	139.321
July	40.260	31.707	183.511	142.517
August	41.582	.....	188.731	.....
September	42.410	32. 975	193.074	.....
October	40.462	30.294	184.837	.....
November	39.810	33.304	180.869	139.391
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.45	October	
May		November	
June		December	

AMERICAN SOCIETY OF MEXICO.

The Society of the American Colony of Mexico City has been reorganized on broader lines, under the name of "The American Society of Mexico."

At a mass meeting recently held in the City of Mexico a new Board of Directors was elected, together with the following named officers: President: R. M. Raymond; Vice President, Dr. Sidney Ulfelder; Secretary, J. D. Helm; and Treasurer S. S. Conger.

At a later meeting the Society adopted a new Constitution and By Laws, providing for permanent organization. This is broad in scope, to cover present and future needs.

The object of the Society as stated, is to promote the welfare of the American residents of the Republic of Mexico. Among other powers the Society is authorized to take cognizance of and act upon all subjects of general interest of its members; to promote and establish mutual cooperative relations; to cooperate with and assist other American institutions of Mexico; to provide, when expedient, a home or house for the accommodation of its members; and to acquire property when desirable for the uses of the Society.

All properly recommended nationals of the United States of America, either men or women residents of the Republic of Mexico, may become members of the Society by signing cards of registration.

The principal office of the Society is to be in the City of Mexico, but branch offices may be established elsewhere.

Heretofore the membership has been limited to men. but in the reorganization the women are invited to join. The present membership of about 1,300 will at once be largely increased.

A cordial invitation is extended to all Americans, men and women, throughout the Republic to identify themselves with this movement for mutual benefit. Naturally the Society will be non-political and non-sectarian. It is also entirely democratic and requires of applicants nothing more than a recommendation as to good character.

It is hoped that Americans of all occupations throughout the Republic will recognize the importance of such an organization and will identify themselves with it. If they do real benefits can be secured for all concerned.

There is need for a strong Society and better opportunities for acquaintance than have heretofere existed among the Americans so widely scattered over this great and undeveloped country. It is important that more and reliable information be had of the Americans living in Mexico, and that a common channel of communication be provided for various purposes. This will give an opportunity for united expression of sentiment and united action in matters relating to the common good. It will make possible a registration of American residents that has not existed heretofore.

When the plans are fully developed in the course of time the Society will be able to provide a Club or meeting place for Americans from all parts of the Republic when they visit the capital; meantime it can be made useful as a source of information to non-resident members.

All who feel an interest are invited to correspond with.

J. D. HELM, Secretary.

408 LA MUTUA, MEXICO, D. F.

While the first purpose of continuous counter current decantation is to displace valuable solution simply, completly and cheaply, extraction also is benefited by reason of the incidental agitation and contact with fresh solution. Any number of different arrangements may be made in the sequence of thickeners and agitators to take advantage of conditions.

Although in most large plants precipitate is refined and smelted in reveberatory and blast furnaces, the Tonopah-Belmont reduces its bullion at minimum cost in a single operation in a tilting furnace. In small plants too it is in many cases more economical to ship to smelters than to refine at the plant.

The flotation process depends upon certain physical phonomena quite different from those made use of in ordinary water-concentrating processes. Certain minerals having a metallic lustre particularly the sulphides, sulpharsenides, sulphantimonides and tellurides, together with native sulphur and graphite, are easily wetted by oil while the usual gangue minerals are not. There is an exception to this rule in that certain of the carbonates, particularly, calcite and siderite, are rather easly oiled by the fatty oils, apparently because a certain amount of actual combination, sapontification takes place. The minerals mentioned as well as oils readily attach themselves to bubbles of gas even in the presence of water. Both the repulsion of water for oil and the lower specific gravity of the gas bubbles and attached mineral particles seem to be of use in the flotation process.

The Fink process for the recovery of zinc from complex ores depends upon "igneuos concentration" or concentration by means of heat. The Fink furnaces is a revolving hollow cylinder, somewhat like a barrel copper convertor. After it is charged the furnace is revolved while being heated and air is blown through the charge. In this way the zinc is oxidized and driven off to be collected in dust chambers. One of the disadvantages is that the fume is difficult to handle and is impure from admixture of other volatile oxides.

Metal Statistics, 1915. New York: The American Metal Market Company.

This well-known hand-book appears this years in more than its accustomed completeness, as coal, petroleum, and cement are now included, which, though extensions of the original design of the compilation as evidenced by its title, cannot but add to its value. The value of the work is naturally mainly for departments of the mineral industry, in which the United States occupy a predominant position, and for which the excellent statistics of the National Geological Survey and the American Iron & Steel Institute afford an excellaut series of records. In addition to the numerous tables of production in the various categories, very complete lists, both American and English, are given, and convenient tables for conversion.

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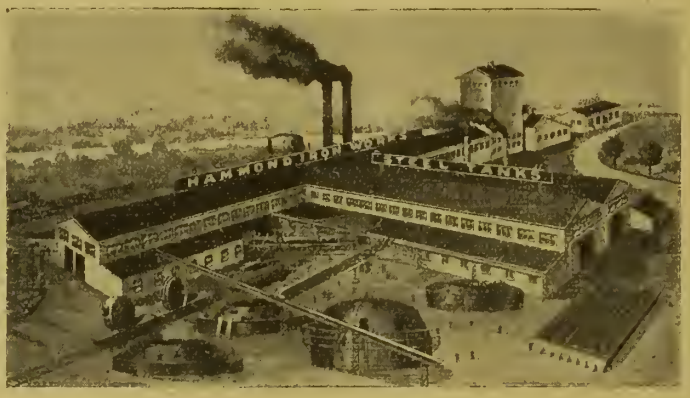

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El Radio y su Distribución.

Es una gran fortuna para la humanidad que el tan deseado elemento no se encuentre en forma concentrada, pues la acción de sus rayos sobre las celdillas animales es tal que al descubrirse los minerales conteniendo el citado elemento en forma concentrada todos aquellos que hicieran el descubrimiento sufrirían serios trastornos y si intentaran hacer extensos exámenes sin tomar las debidas precauciones les sobrevendría la muerte.

El radio se encuentra en ciertos minerales sólo en forma muy diluida; pero lativa amplitud en todo el mundo, no siendo difícil que el radio haya tenido alguna influencia en algunos de los cambios químicos y físicos que se han operado en el proceso geológico. Este es un asunto que ha despertado la atención entre los hombres de ciencia y que mucho se preocupan por su investigación.

El hecho de que el radio se encuentre distribuido extensamente en todo el mundo es bien conocido no sólo por indicaciones de él encontradas en ciertos minerales que ocurren en la superficie de la tierra o cerca de ella sino también por el hecho de que ciertas aguas minerales procedentes de profundidades desconocidas demuestarn contener dicho elemento.

Estas aguas radio-activas se encuentran en distintos puntos separadas por grandes distancias y probablemente proceden de grandes profundidades, cuyos hechos son pruebas de que en toda la tierra existe diseminado en mayor o menor cantidad el radio.

La Concentración en Conección con el Tratamiento de Cianuración de los Metales de Baja Ley.

En el Boletín del mes de noviembre del Instituto Americano de Ingenieros Mineros los Sres Thomas Crowe y G. H. Clevenger discuten este importante asunto exponiendo el Sr. Crowe entre otros conceptos los siguientes:

"El interés manifestado de poco tiempo a esta parte en el tratamiento de minerales de baja ley junto con la discusión de la práctica en la molienda y metalurgia de la Nipissing Mining Co., me hace qe agregue unas cuantas observaciones respecto a la concentración en relación con la cianuración de minerales de baja ley. El Sr. Clevenger en esta discusión no condena la concentración en ese sentido, pero no obstante, el tono de sus observaciones, lo hace que se crea que sus conclusiones son lo mismo que las de otros muchos, es decir, que la concentración es frecuente puesta en práctica como el último recurso para mejorar u obtener una extracción de un mineral por la recolección y venta de la porción refractaria del mineral. Este, yo me atrevo a afirmarlo, no es siempre el caso. La concentración en conección con la cianuración frecuentemente desempeña una función enteramente diferente, por ejemplo, la de evitar el molido fino.

Siendo la economía el objeto principal que se persigue para el tratamiento provechoso de minerales de baja ley, el problema por lo regular se convierte más bien en comercial que en metalúrgico pues generalmente existe un radio entre el costo de operación, grado de pulverización y porcentaje de extracción imponiendo un límite sobre esos factores, por lo común, el grado o calidad del mineral en tratamiento.

Moliendo con muchos minerales es la partida más costosa en su tratamiento, de allí que el grado de pulverización sea muy fácil de ser gobernado por el costo admitido de operación.

Con la mayoría de los minerales el grado de pulverización controla en gran parte el porcentaje de extracción; por lo cual en el tratamiento de minerales de baja ley frecuentemente se hace necesario sacrificar la extracción por medio del molido grueso para la economía del costo con el objeto de que el costo mayor final pueda ser obtenido, siendo solo bajo esas condiciones cuando le es posible a la concentración desempeñar un importante papel sobreponiéndose en gran parte a los efectos de los tamices.

Los metales preciosos que se encuentran en un mineral están por lo regular íntimamente asociados con la porción metálica del mismo y como esta porción metálica está generalmente librada de la ganga a un grueso tamiz relativamente grande, el molido subsecuente del mineral es necesario únicamente con el objeto de que la porción metálica pueda ser reducida a una finura suficiente para que la parte valiosa de él pueda ser disuelta por las soluciones de cianuro en un período de tiempo razonable.

La mesa de concentración bajo esas condiciones tendrá el efecto de separar esta parte metálica refractaria siendo esta especialmente eficaz para separar esa porción que no está suficientemente fina para ser disuelta desde luego en las soluciones de cianuro poniendo la pequeña cantidad de concentrado rico en un montón por separado en donde pueda ser tratado por métodos más extensos, siendo estos de un valor que sea suficiente para justificar el molido subsecuente por tonelada y el contacto más largo, así como la compensación por métodos más laboriosos simplificando al mismo tiempo el tratamiento ulterior del mineral en bruto y terminado o completando los mismos resultados como si toda la masa de mineral hubiera sido molida a una finura muy grande.

Un ejemplo de los efectos de la concentración en conección con la cianuración en el tratamiento de minerales de baja ley puede verse en los molinos del distrito minero de Cripple Creek los cuales están tratando los desechos de minerales sulfo-telurosos. Allí la concentración desempeña otra función aparte de la de evitar o economizar el molido se ha descrito antes. Por razón de la manera tan peculiar de como ocurren las leyes en esos minerales los sulfo-telurosos que aparecen en las caras y costuras de la roca cuando el mineral es triturado a 30 mallas se ha encontrado que los sulfo-telurosos están liberados a tal grado, que después de la concentración y clasificación, el producto arenoso de esas operaciones es de tan baja ley que no podría admitirse sino como desecho.

Los costos admisibles por estos desechos de 50 por ciento del mineral en la forma de arenas de bajo valor puede calcularse su valor perfectamente. De hecho, el éxito de esos molinos en el tratamiento de este sub-producto de baja ley es posible únicamente por medio de la eliminación continua de ese material

el cual no soporta subsecuentets tratamientos. Esto se practica por medio de la eliminación continua de ese material el cual no soporta subsecuentes tratamientos. Esto se practica por medio de otros métodos de concentración aparte de las mesas de concentración tales como el escogido a mano, trituración gruesa y tamización giratoria, y yo por mi parte, me atrevería a hacer una predicción para el futuro con respecto a los métodos selectivos para la molienda de minerales de baja ley, y es de la de que ésta prevalecerá viniendo a ser la concentración un factor importante."

Contestando al Sr. Crowe el Sr. Clevenger expuso:

"Lo principal de la cuestión del tratamiento del mineral es, por supuesto, una cuestión de economía a la que frecuentemente sacrificamos nuestras teorías metalúrgicas más queridas para lograr la mayor utilidad final. Si la recolección de una porción de oro y plata puede ser verificada más económicamente por la concentración que por la solución de cianuro, para obviar se practicará indudablemente la concentración. El caso citado por el Sr. Crowe es una excepción en su más contundente argumento para la concentración es que la arena es desechada sin tratamiento ulterior si se separa el concentrado. Debe recordarse en este sentido que el mineral tratado tiene un valor inferior a $3.00 por tonelada y de que una gran parte de los minerales conteniendo el oro ocurren en los planes de cristalización. Aun con la misma condición del mineral si es de un valor considerablemente más alto no sería posible desechar las arenas sin incurrir en una seria pérdida. El carácter de muchos de los minerales de baja ley de otros distritos harán que esta práctica sea imposible. La falta de lugares a propósito para establecer molinos por razón del gran espacio que necesitan los tanques de lixiviación, juntamente con los contratos favorables de las fundiciones, son factores en el distrito minero de Cripple Creek que no dejan de tener una cierta influencia."

Existen ciertas variaciones posibles en la concentración en conjunto con la cianuración de los cuales las más importantes son:

1. Trituración del mineral en concentración húmeda ya sea directamente o siguiendo otra operación de recolección como la amalgamación, objeción a las lamas y cianuración del concentrado. Este método es más propio su uso para minerales de muy baja ley o para desechos. Un buen ejemplo de tal práctica es la planta de Treadwell en donde los terrenos para la amalgamación del mineral tratado de muy baja ley no podría ser costeable su tratamiento por medio de la cianuración directa, no así la cianuración del concentrado colectado de los terrenos por concentración que proporciona una hermosa utilidad."

"2. Trituración del mineral en solución de cianuro y concentración seguida de la cianuración de las arenas y lamas. Concentrado tratado por medio de uno de los tres métodos:

(a) Embarque de los concentrados a la fundición.

(b) Tratamiento o beneficio especial de la localidad para el tratamiento del concentrado.

(c) Tratamiento especial de la corriente de concentrado como por ejemplo, pulverización fina o amalgamación y regreso de la corriente de concentrado al resto de la pasta para la cianuración.

El método (a) de disponer del concentrado se ha practicado mucho en lo pasado, pero deberá tenerse mucho cuidado al practicarse este método porque quizá, como antes he dicho en otros trabajos sobre esta materia, es muy fácil que a la fundición se le pague mucho más caro por la recolección del oro y la plata que por la cianuración en condiciones debidas.

El método (b) que requiere tratamiento químico o torrificación posterior a la cianuración del concentrado ha sido practicado, y este, bajo ciertas condiciones, puede ser ventajoso.

El método (c) tiene sus adherentes y bajo condiciones favorables puede presentar ciertas ventajas. Sin embargo, existe actualmente una tendencia a retroceder de este método al método (b) más aún cuando es posible obtener una recolección tan alta como con el método (c) por la razón de que si el residuo del concentrado se tiene separadamente puede después llegar a ser una partida interesante del activo.

3. Triturando el mineral en agua o en solución de cianuro y separando de la pasta las lamas y arenas la concentración de cualquiera de las dos o de ambas y desecho de las lamas o arenas y cianuración del otro producto. Un ejemplo de esto es la antigua práctica de Homestake en donde después de triturar en agua y amalgamar las lamas fueron desechadas por ser de muy baja ley para el tratamiento productivo hasta que no vino el desarrollo de las prensas-filtros de Merrill. Las arenas en este caso fueron tratadas por cianuración sin concentración. En el molino Portland Victor las arenas son desechadas después de la concentración y las lamas tratadas por cianuración.

Cemento Util.

Para hacer un buen cemento para hierro colado tómense dos onzas de sal amoniaco, una onza de azufre y diez y seis onzas de limaduras o virutas de hierro fundido. Mézclese todo bien en un mortero y consérvese seco. Cuando se quiera usar, tómese una parte de este polvo por veinte partes de limaduras o virutas de hierro y mézclense bien en un mortero. Hágase con esta mezcla una pasta espesa agregándole un poco de agua, y entonces quedará lista para su empleo. El cemento puede mejorarse agregándole un poco de arena fina.

La República de Colombia, S. A.

La naturaleza al repartir sus tesoros al mundo, se mostró sumamente pródiga con Colombia a quien donó todo género de riquezas, ya en forma de exhuberantes terrenos cruzados de múltiples y abundantes ríos, que al mismo tiempo son fuentes generatrices de fuerza motriz en algunos puntos, que al ser efectivo su total aprovechamiento proporcionarán muchos millares de caballos de fuerza; bien en forma de espesos bosques de finísimas maderas, cuya explotación ya produce sumas fabulosas no obstante estar sólo explotadas en una pequeñísima parte o bien en forma de abundantes yacimientos de metales valiosos como el platino, con cuyos depósitos solo Rusia compite en abundancia y riqueza, existiendo también un gran número de riquísimas vetas de oro que están produciendo algunas de ellas desde la época de la conquista, así como numerosas vetas de plata, cobre, etc., etc.

Colombia está situada al N. O. de la América Meridional, teniendo como vecinas y colindantes a les Repúblicas de Costa Rica, Venezuela, Brazil, Perú y Ecuador. Sus costas miden por el Atlántico como 2,650 kilómetros y por el Pacífico como 2,570 teniendo en ambos océanos numerosas bahías y puertos accesibles a las naves de mayor calado siendo los principales, en el Atlántico, Riohacha, Santa Marta, Puerto Colombia, Cartagena y Colón, y en el Pacífico Panamá, Buenaventura, Nuquí y Tumaco.

La extensión territorial de Colombia se calcula en un millón cuatrocientos veinticinco mil cuatrocientos setenta kilómetros cuadrados, en cuya extensión está calculada la de las islas que aproximadamente suma mil doscientos cincuenta kilómetros cuadrados, de cuya cifra total de superficie, un millón de kilómetros cuadrados permanece baldío y sin cultivo. Su población, según el censo de 1912, monta a 5.472,604 habitantes entre los que sólo se cuentan unos 300,000 indígenas, pues el resto toda es de raza blanca.

El Gobierno de Colombia está constituido en forma de República unitaria por los Departamentos de Cundinamarca, Atlántico, Caldas, Santander, Tolima, El Valle, Boyacá, Antioquia, Nariño, Bolivar, Santander Norte, Cauca, Huila y Magdalena y sus leyes son altamente protectoras del capital y de todas aquellas personas que dediquen sus energías a la explotación de alguna de sus fuentes de riquezas, gozando los extranjeros de toda clase de garantías.

Las exportaciones de Colombia en el año de 1905 fueron por valor de..... $10.608,394 dólares y esta cifra en 1912 ascendió a $32.221,746 dólares contra.. $23.964,623 dólares que importaron sus importaciones en el mismo año.

Las ciudades principales de la República Colombiana son las siguientes:

Bogotá, Capital de la República, si-

tuada a los 4° 36' 0" de latitud N. y 76° 34' 8" de longitud occidental del Meridiano de París, y a 2,640 metros sobre el nivel del mar con una temperatura media de 13° siendo su población de 140,000 habitantes.

Medellín, Capital del Departamento de Antioquía, a 1,541 metros sobre el nivel del mar, con temperaturas de 20° y con una población de 71,004 habitantes.

Barranquilla, Capital del Departamento del Atlántico a 7 metros sobre el nivel del mar, con temperatura de 27°. Su población es de 50,000 habitantes. Su posición es notable por hallarse situada en la ribera occidental del río navegable Magdalena y comunicada con el mar por un ferrocarril que mide 2 miriámetros 5 kilómetros, el cual llega hasta Puerto Colombia.

Cartagena, Capital del Departamento de Bolívar, con temperatura de 27°, y está situada a orillas del mar siendo un puerto interesante. Su población es de 36,632 habitantes.

Santamarta, Capital del Departamento del Magdalena con temperatura de 20°. Tiene buen puerto y su población es de 10,000 habitantes.

Manizales, Capital del Departamento de Caldas, a 2,140 metros sobre el nivel del mar, con temperatura de 17° siendo su población de 34,720 habitantes.

Cúcuta, Capital del Departamento Norte de Santander a 331 metros sobre el nivel del mar, con temperatura de 25° y con una población de 20,364.

Buramanga, Capital del Departamento de Santander, a 925 metros sobre el nivel del mar, con temperatura de 22°, y su población es de 20,000 habitantes.

Popayan, Capital del Departamento del Cauca, 1,741 metros sobre el nivel del mar, con temperatura de 18°. Su población es de 18,724 habitantes.

Pasto, Capital del Departamento de Nariño, a 2,638 metros sobre el nivel del mar, con temperatura de 14°. Su población es de 27,760 habitantes.

Ibagué, Capital del Departamento del Tolima, a 1,299 metros sobre el nivel del mar, con temperatura de 20°. Su población es de 24,693 habitantes.

Tunja, Capital del Departamento de Boyacá, a 2,793 metros sobre el nivel del mar, con temperatura de 13°. Su población es de 8,971 habitantes.

Neiva, Capital del Departamento del Huila, a 468 metros sobre el nivel del mar, con temperatura de 27°. Su población es de 21,815 habitantes.

Cali, Capital del Departamento del Valle, a 1,046 metros sobre el nivel del mar con temperatura de 22°. Su población es de 27,747 habitantes.

Existen además en la República como 1,475 poblaciones, inclusive algunos caseríos de importancia.

Por los datos anteriores se verá que en Colombia se disfruta de todos los climas teniendo una gran analogía su temperatura en general con la de la Europa Occidental, con la gran diferencia de que la mortalidad anual registrada en esa República es relativamente insignificante comparada con las de los países situados en dicha región, circunstancia que también se debe al extremado cuidado y atenciones que el actual Gobierno Colombiano presta a la defensa de la higiene sosteniéndose al efecto estaciones sanitarias en los principales puertos, las cuales están dotadas con todo lo necesario y atendidas por un personal médico cuidadosamente seleccionado.

El desarrollo de la industria en general de Colombia se puede decir que está en principio, pero no obstante esto cuenta ya con importantes fábricas de hilados y tejidos en Bogotá, Medellín, Envigado, Cartagena y Samacá; con cervecerías en las dos primeras ciudades antes citadas, con fábricas de fósforos, con molinos harineros de gran magnitud, con muchos talleres mecánicos y fundiciones altamente favorables que tienen ñas piezas de maquinaria. Una empresa digna de especial mención por su magnitud es la refinería de azúcar de Sincerín, negociación que vale, sin incluir el valor de cuarenta y siete colonias y haciendas de caña que posee, más de millón y medio de dólares. Se puede decir que en Colombia están representadas todas las industrias aunque en una escala muy reducida.

Su industria agrícola es muy interesante no obstante estar reducida a una insignificante parte de su territorio, pero aun así es muy elocuente el hecho de que sola se pueda abastecer de todo lo que necesita en materia de comestibles para sus cinco y medio millones de habitantes que la pueblan. La ganadería también es muy interesante por las condiciones altamentet favorables que tienen sus terrenos para el caso, la abundancia de sus forrajes y lo no escaso de veneros y corrientes de buena agua con que cuenta.

En la actualidad exporta ganado a Cuba y a otras naciones, no siendo difícil que en épocas no muy lejanas pueda estar a la altura de cualquiera de las naciones que en esta industria estén más aventajadas.

Una de las industrias que promete dentro de muy poco tiempo es a no dudarlo la minería. La abundancia de sus yacimientos y lo rico de sus metales es proverbial, llamando esta circunstancia la atención de sabios y notables exploradores que como Humboldt, Codazzi y Shenek se han expresado con gran entusiasmo a este respecto.

En la época de la conquista fué la única industria que explotaban los colonos y pobladores del país, cuyos naturales, y esto es perfectamente conocido, poseían cuantiosas riquezas consistentes en estatuas y figuras macizas de oro y plata, de muchas de las cuales fueron despojados por los ambiciosos conquistadores iberos, pero que la mayor parte de esos tesoros fueron arrojados a los lagos, del mismo modo que lo hicieron los Aztecas en México, antes que darlos a dichos advenedizos iberos.

Según cálculos estadísticos de que se ha podido disponer, Colombia ha producido, desde la época de la conquista hasta el año de 1900, ochocientos y tantos millones de pesos oro en ese metal, representando esta suma solamente la cuarta parte de lo que dicho país hubiera podido producir si sus muchas guerras y trastornos políticos no hubieran tenido verificativo. Pero desde 1900 la nación goza de completa paz la cual no ha sido interrumpida desde entonces, y por lo que se ve, tampoco existen indicios de que pueda serlo.

En estos últimos años el promedio de la producción anual aurífera fué de.... $7.000,000.00 de los cuales corresponden como producción anual cuatro y medio millones al Departamento de Antioquía solamente. Este Departamento es notable por el infinito número de minas que en él existen, pues siendo su superficie de 72,000 kilómetros cuadrados se han titulado desde el año de 1733 la enorme cifra de 12,728 minas de las cuales el mayor número de estas son de oro. El oro de placer también existe en abundancia, y puede decirse sin exageración que en la mayor parte de los ríos o arroyuelos que cruzan este Departamente existen lavaderos de ese precioso metal.

La Intendencia del Chocó es también notable por la riqueza de sus montañas en platino y oro existiendo actualmente en explotación como veintitantas propiedades, y tituladas como trescientas ochenta y tantas. En la misma región existen valiosas vetas de plata y molibdeno así como extensos yacimientos de sulfuros de cobre, plomo, etc. Las minas de cobre de esta región son de la más ricas que existen en el país habiendo partes en donde el mineral ensayado dió un veintiocho por ciento de ley de cobre, según análisis practicados por los señores Lleras y Codazzi. La situación de esta región es ventajosísima para este género de explotaciones, pues tiene costas en ambos mares y lo cruzan a la vez los ríos San Juan y el Atrata, ríos de los cuales se ha hablado mucho con motivo del canal que trataban de abrir papara comunicar ambos océanos.

En la mayor parte del territorio colombiano existen valiosos yacimientos petrolíferos, pues en todas partes se ven manifestaciones más o menos notables de su presencia, por cuyas razones las compañías "Standard" y "Pearson" han estado trabajando con el Gobierno de dicha nación para conseguir concesiones exclusivas para la explotación de tan precioso líquido, concesiones que, dada la poca voluntad que se les tienen a los monopolios en esas regiones y las buenas intenciones del Gobierno que actualmente rige los destinos de Colombia no se cree posible se concedan tales exclusivismos.

El petróleo está ya en explotación actualmente en Santander y Cartagena y no es nada difícil que en un período de tiempo muy corto alcancen dichas explotaciones sumas crecidas dadas las es-

peciales ventajas que geográficamente tiene Colombia y su proximidad al Canal de Panamá, cuyas circunstancias le permiten competir ventajosamente con las demás naciones productoras de dicho combustible.

Para dar una ligera idea de la importancia que puede tener la minería en época no muy lejana en esa privilegiada República, paso a dar a continuación algunos datos respecto a tan interesante industria en los distintos Departamentos.

El Departamento de Bolívar cuya extensión mide 66,865 kilómetros cuadrados, de los cuales como cerca de la tercera parte permanecen baldíos, existen diez minas en explotación activa y sesenta denunciadas.

En el Departamento de Boyaca siendo su superficie de 8,630 kilómetros cuadrados de los cuales más de la mitad está baldía posee además de las famosas minas de esmeraldas, propiedad de la Nación, 157 minas de esmeraldas propiedad de particulares, 11 minas de oro, 12 de cobre, 12 de plata, 2 criaderos de mármol de buena calidad y 3 minas de cinabrio.

Caldas, cuyo Departamento mide una extensión superficial aproximada de 8,500 kilómetros cuadrados tiene denunciadas en la actualidad 2,610 minas de distintos metales representando ademas una gran riqueza aurífera los lechos de los ríos que lo cruzan.

El Departamento de Cauca con una superficie de 24,975 kilómetros cuadrados hay denunciadas 4,106 minas de oro y como el Departamento de Caldas, sus ríos representan también una riqueza en lavaderos del mismo metal.

En el Departamento de Cundinamarca cuya superficie monta a 22,350 kilómetros cuadrados existen grandes criaderos de hierro de excelente calidad que desafortunadamente para el país estos han sido, al igual de la mayoría del resto de sus minas, explotadas de una manera muy deficiente. Existen también en este Departamento numerosas minas de oro, plata, cobre, plomo, cristales de roca, alumbre, así como ricos criaderos de hulla, asfalto y mármoles. Posee también numerosas y abundantes salinas de excelente calidad.

Valle, Departamento fundado en 1910 con una extensión de 28,000 kilómetros cuadrados están denuciadas en él desde dicha fecha, 446 minas de oro; 30 de platino; de plata y oro 165; de amianto 1; de talco 1 y una de cobre. Existen además criaderos de hierro así como yacimientos de carbón de piedra y cristal de roca.

En una extensión de 23,000 kilómetros cuadrados que mide el Departamento de Huila tiene varias minas de oro de las cuales cuatro están en la actualidad en activa explotación. Este Departamento es famoso por la extremada riqueza de los lavaderos de oro que posee en los lechos de sus muchos ríos que lo surcan.

En el Departamento de Nariño que tiene aproximadamente una extensión de 30,000 kilómetros cuadrados han sido denunciadas desde 1904, fecha de su erección en Departamento 2,452 minas entre aluviones y vetas, teniéndose en formal explotación actualmente 7 minas de oro.

No dispongo de datos fijos respecto a las minas existentes en el Departamento Norte de Santander que tiene por superficie 20,000 kilómetros cuadrados, pero es bien sabido que existen numerosas minas de oro, plata, cobre, hierro, etc., así como ricos yacimientos de carbón de piedra y hulla.

El Departamento de Tolima con una extensión superficial de 23,800 kilómetros cuadrados es de los que siguen a Antioquía en producción mineral tiene 593 minas de oro y plata estando muchas de ellas en explotación.

Para terminar diré que para el hombre progresista que procura un buen campo de acción y un lugar para invertir con seguridad y provecho su capital, Colombia tiene y proporciona todas las ventajas deseables.

En subsecuentes números me ocuparé de dar más datos de tan interesante como simpático país.

*Las Salinas de Ojo de Liebre en Baja California, Mex.**

Las salinas de Ojo de Liebre que se encuentran en el lugar más meridional visitado por nosotros, están situadas aproximadamente en la latitud de 27° 40′, y la longitud de 114° 15′, W. Greenwich. Las salinas forman los extremos interiores de la extensa laguna del mismo nombre, que así como las lagunas de San José, de Santo Domingo y otras escota en esta región la línea curva de la costa; ésta pertenece a la parte meridional de la bahía de Sebastián Vizcaíno. La laguna de Ojo de Liebre fué llamada "Scamon's lagon" por los americanos, pero conservamos aquí el nombre español, con el cual la designan los habitantes de Calamahí y de San Ignacio. Hacia el interior y cerca de la costa comienzan enormes llanos que en parte llevan el nombre de los Llanos del Berrendo; principian en el Norte cerca de la desembocadura del río de San Xavier y continuúan por centenares de kilómetros hacia el Sur; su ancho llega a ser más de 100 kilómertso.

El borde occidental de estos llanos está cubierto de enormes médanos, que en parte se extienden a gran distancia tierra adentro. Estos grandes llanos representan actualmentet un desierto con vegetación escasa, donde existen muy pocos aguajes.

En ninguna parte están cortados por causes de ríos o torrentes, pues como ya lo hemos mencionado, los ríos y arroyos que bajan de la Sierra del Paraíso y de las sieras más al Sur, se pierden precisamente allí donde entran en las llanuras de la costa.

En varios lugares de estos llanos existen corrientes subterráneas de agua; éstas fueron observadas por nosotros en el río de San Xavier, cerca del puerto de Santo Domingo y en el Ojo de Liebre. A veces se encuentra el agua casi a flor de tierra (Ojo de Liebre y río de San Xavier) otras veces en una profundidad no muy grande (8m. en Santo Domingo). El agua de todos estos lugares es completamente potable, la de Santo Domingo es ligeramente salada, la de San Xavier y de Ojo de Liebre es perfectamente dulce. Según nuestra opinión existe agua subterránea en muchas partes de estas llanuras en mayor o menor profundidad, y nos parece que cerca de la costa el agua se encontrará en una profundidad algo menor que en el interior de los llanos. Esta posibilidad de hacer nuevos pozos en distintos lugares, tiene una gran importancia en varios sentidos: primero, se facilitaría mucho la explotación de las salinas, se podrían construir nuevas vías de comunicación, y por último, se podría probablemente introducir ganado en varias partes, donde hoy no es posible a causa de la falta de agua. En los llanos de San Luis Gonzaga (ex-misión al Este de la bahía de la Magdalena), existen, según las noticias que hemos podido obtener, condiciones muy semejantes, y allí el Sr. Benigno de la Toba ha logrado encontrar agua en numerosos lugares y a consecuencia de esto ha podido introducir y mantener gran cantidad de ganado en aquellas llanuras.

En estas llanuras penetran rodeados por series de médanos, senos alargados en forma de lenguas en cuya superficie existe una capa no interrumpida de sal blanca; éstas son las conocidas salinas de Ojo de Liebre.

Hemos distinguido cuatro diferentes senos o salinas sólo dos de éstas eran conocidas por la gente del rumbo bajo un nombre especial, a saber, la salina que queda más al Sur y que probablemente tiene una extensión de unos 12 kilómetros o más, que se designa con el nombre de la Salina Grande, y la salina que está situada un poco más al Norte, que se llama comúnmente la Salina Chica. A una tercera salina que está conectada con la Salina Chica, pero que queda en un seno un poco más al Norte, la hemos llamado Salina del Pescador, por quedar frente a ella la choza de un pescador de tortugas. Hacia el Norte sigue un seno grande que contiene un depósito de sal de poca importancia, y en tiempo de nuestra visita, cubierta con agua; esta salina la hemos designado como la Salina del Norte.

No hemos estudiado con detenimiento la Salina del Norte, pues a causa de su grande extensión nos habría costado mucho tiempo; como vimos que la salina económicamente no será de tal importancia como las del Sur, no quisimos dedicar a su estudio un tiempo que lo podíamos emplear de una manera más útil.

* Parergones del Instituto Geológico de México.

Los senos que contienen las salinas muestran una capa continua de sal blanca relumbrante, que hacia el Oeste, es decir, hacia la laguna abierta disminuye en espesor y se cubre con una solución saturada de sal; más hacia la orilla del agua de la laguna desaparece la sal por completo y la solución de sal cubre a un suelo fangoso, conocido en aquella región bajo el nombre de atascadero. Durante las mareas más altas toda la capa de sal llega a cubrirse con el agua del mar; más abajo discutiremos la importancia de estos inundaciones temporales para la regeneración de la sal .

Para poder estudiar la formación de la sal así como su importancia comercial, hemos hecho en las tras salinas 47 pozos de diferente profundidad y a diferente distancia.

Los pozos no fueron hechos en intervalos iguales, sino cerca del borde de la salina hicimos en lo general mayor número de excavaciones para poder determinar de qué modo aumenta el espesor de la sal. En el centro de las salinas hemos hecho pozos con intervalos más grandes, porque la experiencia y la observación nos enseñó luego que allí donde la superficie de la cubierta de sal está cruzada por numerosas fracturas cimentadas por sal, lo que le da el aspecto de un río con una capa de hielo, esta cubierta es siempre de gran espesor más o menos uniforme. Donde la sal tenía este aspecto hicimos sólo de vez en cuando un pozo para convencernos de que el espesor realmente no había disminuído. La profundidad de los pozos es también diferente; viendo que claramente se trataba del mismo perfil como en los pozos anteriores, muchas veces, no seguimos excavando. Al ver que la cubierta de sal era muy delgada en lo general, sólo nos hemos convencido que abajo no seguía otra capa. En algunos casos teníamos interés de hacer otro pozo más profundo, pero a veces nos lo impidió la gran cantidad de agua salada que corría hacia el pozo y que a cierta profundidad ya no logramos sacar con bastante rapidez, para poder seguir trabajando. Esta agua salada que más bien es una solución saturada de sal, llenaba todos los pozos en muy poco tiempo. En algunos puntos hemos hecho excavaciones también fuera de las salinas en unas lagunas antiguas secas sin cubierta de sal, para convencernos de si existían o no depósitos de sal más antiguos, pero no hemos podido encontrar ningún depósito de esta clase.

Resultados obtenidos en los pozos ejecutados en la cubierta de sal en las salinas de Ojo de Liebre.

Laguna seca.—Pozo núm. 1.—Profundidad total 1m.15.

Arriba: capa de sal y yeso..... 30 cm.
capa de fango negro... 18 „
arenas de playa..... 30 „
barro amarillo con concreciones de cal..... 37 „

Pozo núm. 2.—Profundidad total, 20 cm.
Arriba: efervescencia de cal con lentes de yeso..... 10 cm.
capa de fango negro... 10 „

Salina del Pescador.—Pozo 2º.—Profundidad total, 1m.30.

Arriba: capa de sal.. .. .. .. 18 cm.
capa de fango con algas descompuestas. .. .. .. 0.5 ,
capa de fango... .. .. 5 „
capa de yeso con arena. 23 „
capa de barro.. .. .. .. 10 „
capa de arena fina con cristales de yeso. .. .. 73.5 „

Pozo núm. 3.—Profundidad total, 40 cm. (Fué hecho en un lugar escarbado recientemente y rellenado de nuevo de sal.)

Arriba: capa de sal.. .. .. .. 15 cm.
capa de arcilla... .. .. 5 „
capa de arenas con yeso. 20 „

Pozo núm. 4.—Profundidad, 60 cm. (Fué hecho en la capa de sal no estorbada a distancia de 8 m. del pozo número 3.)

Arriba: capa de sal... .. .. .. 15 cm.
capa de arcilla.. .. .. 10 „
capa de arena con yeso.. 35 „

Pozo núm. 5.—Profundidad total, 35 cm. (a 100 m. de distancia del pozo número 4.)

Arriba: capa de sal... .. .. .. 10 cm.
capa de arcilla con algas descompuestas... .. .. 11 „
capa de arcilla con yeso. 10 „
capa de arena con yeso.. 4 „

Pozo núm. 6.—Profundidad total, 45 cm. (a 100 m. de distancia del pozo número 5.)

Arriba: capa de sal... .. .. .. 6 cm.
capa de arcilla... .. .. 10 „
capa de arcilla con cristales de yeso... .. .. .. 5 „
capa de arena con yeso. 42 „

Pozo núm. 7.—Profundidad total, 65 cm. (a distancia de 250 m. del pozo número 6.)

Arriba: capa de sal... .. .. .. 5 cm.
capa de arcilla.. .. .. 10 „
capa de arena con yeso. 45 „
capa de arenas de playa blancas. .. .. 5 „

Pozo núm. 8.—Profundidad total, 32 cm. (a distancia de 200 m. del pozo número 7.)

Arriba: capa de sal... .. .. .. 2 cm.
capa de arcilla con algas. 4 „
capa de arena con yeso. 24 „
capa de arena de la playa.. .. .. 2 „

Pozo núm. 9.—Profundidad total, 12 cm. (a distancia de 150 m. del pozo número 8.)

Arriba: capa de sal.. .. .. 6 cm.
capa de arcilla.. .. .. 12 „

Pozo núm. 10.—Profundidad total, 58 cm. (a distancia d e60 m. del pozo número 9.)

Arriba: capa de sal.. .. .. 6 cm.
capa de arcilla con algas.. .. .. 50 „
capa de yeso.. .. .. .. 50 „
capa de arena blanca con yeso... .. .. 1 „

Salina Chica.—Pozo núm. 11.—Profundidad total, 59 cm. (a distancia de 130 m. del pozo número 10.)

Arriba: capa de sal... .. .. .. 12 cm.
capa de arcilla... .. .. 2 „
capa de arcilla con arena y yeso.. .. .. 45 „

Pozo núm. 12.—Profundidad total, 38 cm. (a distancia de 130 m. del pozo número 11.)

Arriba: capa de cal.. .. .. 20 cm.
capa de arcilla.. .. .. 12 „
capa de arena con yeso. 45 „

Pozo núm. 12.—Profundidad total, 38 cm. (a distancia de 130 m. del pozo número 11.))

Arriba: capa de cal.. .. .. 20 cm.
capa de arcilla... .. .. 12 „
capa de arena con yeso. 6 „

Pozo núm. 13.—Profundidad total, 45 cm. (a distancia de 175 m. del pozo número 12.)

Arriba: capa de sal.. .. .. .. 25 cm.
capa de arcilla.. .. .. 2 „
capa de arena con yeso. 18 „

Pozo núm. 14.—Profundidad total, 52 cm. (a distancia de 300 m. del pozo número 13.)

Arriba: capa de sal.. .. .. 29 cm.
capa de arcilla.. .. .. 16 „
capa de arena con yeso. 7 „

Pozo núm. 15.—Profundidad total, 41 cm. (cerca de la orilla del agua.)

Arriba: capa de sal.. .. .. 5 cm.
capa de arcilla con algas... 12 „
capa de arcilla con arena. 12 „

Pozo núm. 16.—Profundidad total, 42 cm. (a distancia de 250 m. del pozo 15 y de aproximadamente 1 kilómetro del pozo número 14.)

Arriba: capa de sal.. .. .. .. 27 cm.
capa de arcilla.. .. .. 2 „
capa de arena con arcilla y yeso.. .. .. 13 „

Pozo núm. 17.—Profundidad total, 40 cm. (a distancia de 250 m. del pozo número 16.)

Arriba: capa de sal.. .. .. 17 cm.
capa de arcilla con cristales de sal.. .. .. .. 1 „
capa de sal.. .. .. 3 „
capa de arcilla.. .. .. .. 1 „
capa de sal.. .. .. 5 „
capa de caliche.. .. .. 1 „
capa de arena y arcilla con yeso.. .. .. .. 7 „

Pozo núm. 18.—Profundidad total, 49 cm. (a distancia de 1 km. del pozo número 17.)

Arriba: capa de sal.. .. .. .. 19 cm.
capa de arcilla con caliche.. .. .. 1 „
capa de sal.. .. .. .. 4 „
capa de arcilla.. .. .. 2 „
capa de sal.. .. .. .. 15 „
capa de arena y arcilla negra.. .. .. 8 „

Pozo núm. 19.—Profundidad total, 48 cm. (a distancia de 1 km. del pozo número 18.)

Arriba: capa de sal.. .. .. .. 17 cm.
capa de caliche.. .. .. 1 „
capa de cal.. .. .. .. 5 „
capa de arcilla. .. .. .. 0.5„
capa de arcilla. .. .. .. 0.5„

Pozo núm. 20.—Profundidad total, 30
capa de arena gris.. .. 13 „
capa de sal.. .. .. .. 1.5„
cm. (a distancia de 1 km. del pozo número 19.)

Arriba: capa de sal.. .. .. .. 17 cm.
capa de caliche con cristales de sal.. .. .. .. 19 „

Pozo núm. 21.—Profundidad total, 27 cm. (a distancia de 1 km. del pozo número 22.)

Arriba: capa de sal.. .. .. .. 17 cm.
capa de caliche.. .. .. 10 „

Pozo núm. 22.—Profundidad total, 47 cm. (a distancia de 1 km. del pozo número 20.)

Arriba: capa de sal.. .. .. 20 cm.
capa de caliche con cristales de sal.. .. .. .. 27 „

Pozo núm. 23.—Profundidad total, 55 cm. (a distancia de 1 km. del pozo número 22.)

Arriba: capa de sal.. .. .. 10 cm.
capa de caliche, arcilla y sal. .. .. 12 „
capa de arcilla negra.. 6 „
capa de arena parda.. 27 „

Pozo núm. 24.—Profundidad total, 43 cm. (a distancia de 300 m. del pozo número 23.)

Arriba: capa de sal.. .. .. .. 14 cm.
capa de caliche, arcilla y sal.. .. .. 16 „
capa de arcilla negra... 3 „
capa de arena parda obscura... .. .. 10 „

Pozo núm. 25.—Profundidad total, 53 cm. (a distancia de 300 m. del pozo número 24.)

Arriba: capa de sal.. .. .. .. 12 cm.
capa de arcilla y sal.. .. 5 „
capa de caliche con sal. 10 „
capa de arcilla negra.. 3 „
capa de arena.. .. .. . 23 „

Pozo núm. 26.—Profundidad total, 47 cm. (a distancia de 500 m. del pozo número 25.)

Arriba: capa de sal.. .. .. .. 10 cm.
capa de sal, arcilla y y caliche. .. .. 7 „
capa de caliche con sal. 15 „
capa de fango.. .. .. . 15 „

Pozo núm. 27.—Profundidad total, 63 cm. (a distancia de 280 m. del pozo número 26.)

Arriba: capa de sal.. .. .. 12 cm.
capa de arcilla con sal y caliche... .. .. 20 „
capa de fango azulado. 5 „
capa de arena arcillosa azulado-gris, con concreciones de cal.. .. .. .. 26 „

Pozo núm. 28.—Profundidad total, 65 cm .(En el borde de la Salina Chica.)

Arriba: arena con restos de conchas.. .. .. 35 cm.
barro con pocos restos de conchas.. .. .. 30 „

Salina Grande.—Pozo núm. 29.—Profundidad total, 1 cm. (cerca del camino para San Andrés.)

Arriba: capa de sal.. .. .. 1 cm.
capa de fuego con mucha agua.

Pozo núm. 30.—Profundidad total, 5 cm.

Arriba: capa de sal.. .. .. .. 3 cm.
capa de arcilla.. .. .... „

Pozo núm. 31.—Profundidad total, 10 cm.

Arriba: capa de sal... .. .. 4 „
capa de arcilla con algas. „

Pozo núm. 32.—Profundidad total, 10 cm.

Arriba: capa de sal.. .. .. 5 cm.
capa de arcilla.. .. .. .. „

Pozo núm. 33.—Profundidad total 15 cm. (a distancia de 1 km. del pozo número 29.)

Arriba: capa de sal.. .. .. 9 cm.
capa de arcilla... .. .. „

Pozo núm. 34.—Profundidad total, 85 cm. (a distancia de 200 m. del pozo número 33.)

Arriba: capa de sal.. .. .. 13 cm.
capa de arcilla negra.. .. 17 „
arena alternando con arcilla.. .. .. 17 „
arcilla calichosa con yeso. 44 „

Pozo núm. 35.—Profundidad total, 30 cm. (a distancia de 200 m. del pozo número 34.)

Arriba: capa de sal.. .. .. 18 cm.
arena y arcilla.. .. .. . 12 „

Pozo núm. 36.—Profundidad total, 37 cm. (a distancia de 300 m. del pozo número 35.)

Arriba: capa de sal color de rosa.. 21 cm.
capa de arcilla.. .. .. . 4 „
capa de caliche con algas. 3 „
capas de arcilla.. .. .. .. 9 „
capas de arcilla.. .. .. .. 9 „

Pozo núm. 37.—Profundidad total, 47 cm. (a distancia de 1 km. del pozo número 36.)

Arriba: capa de sal, bien cristalizada.. .. .. 23 cm.
capa de arcilla con caliche.. .. .. 2 „
capa de barro pardo.. .. 6 „
capa de arcilla calichosa. 16 „

Pozo núm. 38.—Profundidad total, 26 cm. (a distancia de 1 km. del pozo número 37.)

Arriba: capa de sal.. .. .. 23 cm.
capa de arcilla.. .. .. . 3 „

Pozo núm. 38 a.—Profundidad total, 25 cm. (a distancia de 1 km. del pozo número 38.

Arriba: capa de sal.. .. .. 15 cm.
alternación de arcilla con lechos de caliche.. .. .. 10 „

Pozo núm. 39.—Profundidad total, 18 cm. (a distancia de 100 m. del pozo número 38.)

Arriba: capa de sal.. .. .. 16 cm.
arcilla.. .. .. 2 „

Pozo núm. 40.—Profundidad total, 10 cm. (a distancia de 1 km. del pozo núm. 38 a) cerca de la orilla de la salina.

Arriba: capa de sal.. .. .. 3 cm.
caliche.. .. .. 7 „

Pozo núm. 41.—Profundidad total, 17 cm. (a distancia de 1 km. del pozo número 40.)

Arriba: capa de sal.. .. .. 5 cm.
arcilla.. .. .. 2 „
caliche.. .. .. 10 „

Pozo núm. 42.—Profundidad total, 26 cm. (a distancia de 250 m. del pozo número 41.)

Arriba: capa de sal, muy pura, blanca.. .. .. 16 cm.
caliche.. .. .. 10 „

Pozo núm. 43.—Profundidad total, 30 cm. (a distancia de 750 m. del pozo número 42.)

Arriba: capa de sal.. .. .. 20 cm.
arcilla alternando con caliche. .. .. 10 „

Pozo núm. 44.—Profundidad total, 35 cm. (a distancia de 1 km .del pozo número 43.)

Arriba: capa de sal.. .. .. 25 „
arcilla. .. .. 10 „

Pozo núm. 45.—Profundidad total, 20 cm. (a distancia de 1 km. del pozo número 44.)

Arriba: capa de sal.. .. .. 14 cm.
arcilla.. .. .. 6 „

De esta lista vemos que en la salina del Pescador la cubierta de sal tiene el mayor espesor en el centro del seno (18 cm.), sigue bastante gruesa (15 cm.) hacia el Suroeste, disminuyendo después con bastante rapidez hasta el pozo número 8. La causa de estas condiciones es la existencia de una lengua de arena que se extiende hacia el Oeste desde la orilla, cerca del pozo 7 y 8. En realidad el pozo 9 ya pertenece a la cubierta de sal de la Salina Chica, pues está al Sur de la lengua de arena mencionada; hemos juntado los pozos 9 y 10 a la salina del Pescador, porque topográficamente pertenecen a este seno, dado que el banco de arena no se observa en la superficie de la salina y el pozo 10 queda todavía dentro de la ensenada topográfica de la salina del Pescador.

La cubierta de sal de la Salina Chica comienza, pues, ya desde el pozo 9 donde tiene poco espesor (6 cm.); pero aumenta rápidamente en potencia. En el pozo 11 que dista del número 10 sólo 130 m., ya encontramos 12 cm. de sal; en el núm. 12 observamos 20 cm., y en los siguientes 25 cm. y 29 cm. Este último pozo se encuentra ya relativamente cerca de la orilla de la salina; desde allí el grueso de la cubierta de sal debe disminuir rápidamente, porque en el pozo 15 ya no tenemos más de 6 cm. de sal; pero este pozo se encuentra bastantet cerca de la parte pantanosa. Volviéndonos de nuevo hacia adentro de la Salina Chica, vemos que en realidad aumenta muy pronto el espesor de la sal, pues a distancia de 250 m. del pozo 15 encontramos en el pozo 16, de nuevo, una capa de 27 cm. Comparando el corte del

pozo núm. 16 con el del núm. 17, parece a primera vista, que la capa de sal disminuye hacia el interior de la Salina Chica; pero en realidad, la capa de sal está dividida aquí por capas delgadas de arcilla, de manera que encontramos tres diferentes capas de sal que en conjunto tienen una potencia de 25 cm. Todo el aspecto de la superficie demuestra que desde allí para el Sureste continúa el espesor grande de la cubierta de sal, y esta opinión nos la confirman los resultados obtenidos en el pozo núm. 18, que dista un kilómetro del pozo núm. 17. Allí encontramos otra vez tres diferentes capas de sal divididas por otras capitas delgadas de arcilla; el conjunto de los depósitos de sal es todavía más grueso que en el pozo anterior, pues llega a 38 cm. El aspecto de la superficie de la sal sigue siendo el mismo hacia el Sureste, como entre los pozos 17 y 18. En el pozo 19 que dista del pozo número 18 un kilómetro, encontramos, por consecuencia, condiciones muy semejantes. La capa de sal se divide en tres lechos que en conjunto tienen un espesor de casi 25 cm. El pozo 19 se encuentra allí donde el seno empieza a hacerse bastante angosto. Las condiciones probablemente no cambian, lo que indica el aspecto de la cubierta de sal y los resultados de los tres pozos siguientes números 20, 21 y 22. En los dos primeros de éstos, no nos fué posible alcanzar una profundidad muy grande, por la abundancia de solución de sal que se introducía durante el trabajo, de por sí bastante lento a causa de la dureza de la capa de caliche. Probablemente existen allí todavía una o dos capitas más de sal; pero como ya la capa de caliche contiene una gran cantidad de cristales de sal, estos lechos secundarios no pueden influir mucho sobre el cálculo total de la potencia. En los pozos números 20 y 21, hemos encontrado una capa superior de sal de 17 cm. de espesor; debajo de ésta una capa de caliche revuelta con cristales de sal de 19 cm. en uno y de 10 cm. en el otro pozo; de modo que la potencia total de la sal no tendrá aquí mucho menos de 30 cm. En el tercer pozo encontramos una capa superficial de 20 cm. de sal, y debajo de ésta una de 27 cm. de caliche con cristales de sal; tampoco aquí nos fué posible llegar a mayor profundidad por la abundancia de solución de sal y la dureza de la caliche. Los tres pozos discutidos aquí se han ejecutado a distancia de un kilómetro uno del otro, de modo que indican las condiciones en una superficie de 3 km. de largo. El siguiente pozo núm. 23, que dista del anterior otra vez un kilómetro, se encuentra ya casi en el término de la salina, es decir, allí donde ésta se divide en dos brazos angostos separados por un banco de arena; los resultados han revelado un espesor sorprendente de la sal, no obstante de la cercanía de la ribera; la capa de sal pura tiene un grueso de 10 cm., la que sigue abajo y que se compone de sal, lechos de arcilla y caliche, muestra un espesor de 12 cm., de modo que la potencia de sal es por lo menos de 15 cm. Según los resultados de la excavación, ya no siguen capas de sal en la profundidad. Cerca del pozo 23 hemos hecho dos excavaciones más en una línea aproximadamente transversal a la dirección longitudinal de la salina; son los pozos 24 y 25. Estos muestran condiciones todavía más favorables, pues la capa de sal pura tiene un grueso de 14 cm. en el primero y 12 cm. en el otro; los lechos de caliche, arcilla y sal una potencia total de 16 y 15 cm., respectivamente. Los dos pozos distan entre sí y del pozo núm. 23, 300 m., de modo que indican las condiciones en una línea transversal de 600 m. de largo. Para poder determinar las condiciones en los mencionados brazos del seno, hicimos dos pozos en el septentrional, que es el más importante. El resultado fué casi todavía mejor que en la parte ancha de la salina, teniendo la capa de sal pura una potencia de 10 cm., los lechos de arcilla, caliche y sal, una de 22 cm., en el pozo núm. 26, que dista 500 m. del pozo anterior; en el siguiente pozo núm. 27 encontramos una cubierta de sal pura de 12 cm., mientras que los lechos de arcilla, caliche y sal tienen una potencia de 20 cm. En la última parte de la salina, así como en los brazos, corresponde a la sal por lo menos un grueso de unos 20 centímetros.

Al Noreste del brazo septentrional existe un pequeño valle plano sin cubierta de sal; para cerciorarnos acerca de las condiciones del suelo de éste, hemos hecho allí una pequeña excavación (pozo núm. 28) cerca de la orilla de la salina; no hemos encontrado ni una capita de sal y muy poca cantidad de solución saturada de sal.

La Salina Grande está separada de la Salina Chica por un lomerío no muy alto; designamos como Salina Grande solamente la parte que se encuentra al Sur de la vereda a San Andrés, pues lo que se encuentra más al Norte, es una especie de pantano que se extiende hasta la choza del pescador, y que en todas partes ocupa la región entre la salina seca y la orilla de la laguna abierta.

En la Salina Grande hemos hecho 18 pozos que cubren aproximadamente una extensión de 7 km. en sentido longitudinal y por lo menos 3 km. en dirección transversal. Cerca del camino a San Andrés, existe una capa de sal que apenas tiene el grueso de un centímetro; pero avanzando hacia el Sur se observa que el espesor de la cubierta de la sal constantemente, y a distancia de 1 km. del referido camino, tenemos ya 9 centímetros de sal. Una gran parte de este primer tramo está cubierto por solución de sal; más hacia el Sur la cubierta de sal llega a ser completamente seca y su aspecto cambia ; la sal forma una capa sólida y unos 700 metros más al Sur ya se ve de nuevo que la superficie está cruzada por fallas recementadas por sal; indicio seguro de que la cubierta es bastante gruesa. Realmente vemos que en el pozo núm. 36 la capa de sal tiene una potencia de 21 cm. De ahí en adelante queda el aspecto de la cubierta de sal el mismo y los resultados de los pozos 37 y 38 demuestran que la cubierta aumenta en potencia en los dos kilómetros siguientes, hasta un grueso de 23 cm. En los dos pozos que siguen, y que llevan los números 38 A y 39, hemos encontrado una capa de sal un poco menos potentet; pero, probablemente, depende esto de condiciones locales; pues más hacia el Sur la sal toma de nuevo el aspecto descrito ya otras veces, es decir, la superficie está atravesada por numerosas fracturas rellenadas por sal, y esto indica en lo general, que la cubierta pasa de 20 cm. No pudimos ya hacer más pozos en esta dirección, porque nos faltó tiempo, pero lo que hemos estudiado con todo detenimiento, indica una existencia tan enorme de sal, que en caso de explotación no se necesitaría pensar por muchísimos años en la explotación de la parte meridional de la Salina Grande. Hemos extendido nuestras observaciones donde unas señales indican el término de alguna concesión dada anteriormente; pues más al Sur ya no siguen indicaciones de ninguna medida topográfica.

En la parte estudiada con más detenimiento hemos hecho también varios pozos hacia los lados de la línea principal de los sondeos. Los resultados de los pozos 40 y 41, demuestran que cerca del pozo núm. 38 A, deben existir condiciones locales un poco diferentes; probablemente hay aquí un banco de arena que atraviesa el seno y que produce localmente una disminución del espesor de la sal; este banco se nota también superficialmente cerca del pozo 40. En el pozo núm. 42, aumenta la potencia de la sal a 16 cm., no obstante de distar del 41 únicamente 250 m. En el pozo núm. 43, que está a un kilómetro de distancia del pozo núm. 41, encontramos de nuevo una cubierta de 20 cm. de sal. Un poco al Este de nuestra línea longitudinal, aumenta el espesor de la sal todavía más; en el pozo núm. 44 existe una capa con una potencia de 25 cm. Hacia el Noreste sigue este espesor, que disminuye algo cerca de un banco de arena.

En las tres salinas se encuentra la sal más pura en la superficie; ésta es bien cristalizada, perfectamente blanca y se compone principalmente de cloruro de sodio. Debajo de esta capa se encuentra con mucha frecuencia otra que está teñida de un color rosado, y debajo de ésta hay otra que tiene un color verdoso. Estos colores se pierden rápidamente bajo la influencia de la luz, siendo causados por la existencia de restos de algas en estado de descomposición. Las tres capas descritas aquí forman en conjunto lo que hemos designado como la cubierta superior de sal. Allí donde el depósito de sal aumenta mucho en espesor, como en los pozos números 17, 18 y 19, se intercalan pequeños lechos de caliche y arcilla que dividen la par-

te inferior de la sal en diferentes lechos; estos lechos inferiores son de por sí menos puros que la capa o cubierta superior; especialmente contienen una mezcla mayor de cristales de yeso.

Debajo de la cubierta de sal se encuentra siempre una capa de poco espesor compuesta de una arcilla negra, o quizá mejor dicho de un fango mezclado con muchísimos restos de algas. Esta capita despide siempre un fuerte olor de ácido sulfhídrico producido principalmente por la descomposición de las algas. Esta capa de fango arcilloso detiene la solución saturada de sal que rellena los huecos en la parte inferior de la cubierta de sal, impidiendo así que entre en la capa de arena que sigue abajo del fango. La solución de sal está tan saturada, que, cayendo gotas de ella sobre el vestido o sobre piedras, dejan después de pocos minutos, una costra de sal blanca y allí donde la solución rellenaba los pozos, hechos por nosotros vimos después de algunas horas ya que esqueletos de cristalitos de sal empezaban a formarse cubriendo la solución con una especie de nata de sal.

Ya hemos mencionado, que debajo del lecho del fango se encuentra siempre un depósito de arena fina semejante a la que forma la playa del mar; esta arena alterna a veces con una arena arcillosa, sin que llegue a formarse una verdadera capa de arcilla. Las capas arenosas contienen en la parte septentrional de la Salina Chica, así como en la Salina del Pescador, un gran número de cristales de yeso aislados y bien definidos. En la parte meridional de la Salina Chica, no hemos encontrado estos cristales de yeso en la arena, sino encima del depósito de arena, varias capitas de caliche. Hacia el centro de la Salina Chica, aumenta desde el Sur la cantidad de yeso, mientras que el caliche desaparece paulatinamente, y desde el Norte aumenta el caliche mientras que el yeso poco a poco desaparece. Es, pues, evidente que en el Sur de la mencionada región la cal existente fué utilizada para la formación de carbonato, mientras que en la parte Norte fué convertida en sulfato. En la Salina Grande predomina la formación de carbonato de cal, yeso se encontró sólo en algunos lugares y allí, en una forma cristalográfica algo diferente. Mencionaremos aquí que también una parte de los médanos en el borde de las salinas, se compone de una arena de yso.

La serie de observaciones hechas por nosotros en las salinas de Ojo de Liebre, nos permite dar una explicación de la formación de estos depósitos de sal. Todas las salinas se encuentran en los senos interiores de la laguna de Ojo de Liebre, lejanas de las corrientes del mar. Estos senos formaban antes evidentemente parte de la laguna abierta, pero en su desembocadura se formaron con el tiempo barras, así como éstas se han formado en la boca de las lagunas principales de toda esta región de la Baja California. Las barras han servido para cerrar los senos, obstruyéndose así la circulación directa del agua del mar. Debajo del agua salada del mar, encerrada en los senos, se formó una capa de algas cuyos productos de descomposición dieron origen a un lecho de fango arcilloso, cubriéndose así el fondo del seno con una capa impermeable. La formación de esta capa impermeable se observa aún en la actualidad en los bordes de la laguna, en los pantanos o atascaderos. También allí se compone el fondo de arena fina cubierta por una capa delgada de algas y fango producido por la descomposición de éstas, todo cubierto por agua del mar poco profunda. Yendo del atascadero hacia el interior del seno, se observa que poco a poco la capa de fango y algas se cubre con una costra delgada de sal que aumenta paulatinamente en espesor, como nos lo demuestran los resultados obtenidos en los pozos números 29-36.

El agua del mar en los senos cerrados se evapora con bastante rapidez a causa del aire seco y del calor del sol; pero esta agua, naturalmente, sólo podría haber formado una costrita delgadísima de sal; en consecuencia, es necesario que después haya entrado de nuevo el agua del mar. En realidad, entra el mar todavía en la actualidad en estos senos por lo menos parcialmente en la temporada de las altas mareas. De este modo se impidió que el agua que primeramente quedó estancada en los senos se evaporara por completo, y sencillamente se formó una solucion saturada que fue diluida por nueva agua del mar introducida durante las altas mareas. Este procedimiento siguió hasta que todo el seno contenia una solución saturada; pero el procedimiento siguió de la manera descrita, hasta que todo el seno estaba lleno de sal; la solución saturada llena actualmente sólo las partes huecas en la cubierta de sal. Naturalmente era el procedimiento algo más complicado respecto a la formación de las capas inferiores de sal, pero la explicación de estos detalles la dejaremos para nuestro informe geológico.

Las posibilidades de explotación.

Para tener una idea de la posibilidad de explotación de la sal, hay que tomar en consideración: 1°, la cantidad de sal existente; 2°, la calidad de la sal; 3°, el modo de extracción, y 4°, las posibilidades de transporte.

El cálculo de la sal existente sólo se puede hacer de una manera aproximada, porque nos falta un levantamiento exacto de las salinas. No obstante de este grave obstáculo, no hemos dejado de hacer un cálculo por lo menos aproximativo, basándonos en nuestras medidas de superficie y en nuestras observaciones acerca de la potencia de la sal, en los diferentes tramos de las salinas, tomando en consideración también las indicaciones suministradas por el aspecto de la cubierta de sal.

Hemos dividido las diferentets salinas en tramos basándonos en los resultados de nuestros pozos; para no exagerar, hemos tomado como promedio siempre una cifra algo más baja que la indicada por el puro cálculo matemático. Nuestro resultado es que el interior de la salina del Pescador, es decir, desde la orilla hasta la altura de los pozos 3 y 4, contiene 177,187 t. de sal; la parte exterior desde la altura de los pozos 3 y 4 hasta la orilla, contiene 120,750 t., de modo que la salina del Pescador encierra un total de 297,937 t. de sal.

La Salina Grande la hemos dividido en dos tramos. La parte exterior que representa una faja de un ancho de 1m5 entre las dos orillas de la salina, contiene 157,500 t. de sal. El segundo tramo que comprende todo el terreno entre la faja mencionada y una línea transversal que pasa por el pozo 38, contiene 5.040,000 t. de sal. La parte estudiada de la Salina Grande tiene, pues, 5.197,500 t. de sal. El tramo estudiado por nosotros comprende solamente una parte de la Salina Grande, ésta se extiende tanto hacia el interior, que no nos fué posible llegar hasta el límite meridional; pero para no exagerar calculamos el resto solamente como igual a la parte estudiada, aunque en realidad será mucho más grande.

En resumen, vemos que el contenido de sal de las diferentes salinas es:

Salina del Pescador, parte exterior	177,187 t.
Salina del Pescador, parte interior	120,750 t.
Suma	297,750 t.
Salina Chica, parte exterior.	472,500 t.
Salina Chica, parte central.	2.493,750 t.
Salina Chica, parte interior.	472,500 t.
Suma	3.438,750 t.
Salina Grande, parte exterior	157,500 t.
Salina Grande, parte interior	5.040,000 t.
Suma	5.197,500 t.
Salina del Pescador	297,937 t.
Salina Chica	3.438,750 t.
Salina Grande	5.197,500 t.
Suma	8.934,187 t.
A esto añadiremos el contenido del resto de la Salina Grande, calculándolo en	5.000,000 t.
Suma total	13.934,187 t.

Las tres salinas juntas tienen, pues, un contenido de sal que pesa aproximadamente 14 millones de toneladas. Mencionaremos de nuevo que nuestro cálculo se basa sobre cifras bajas, de modo que es en realidad más bien un cálculo de un mínimum de existencia de sal que uno de un promedio.

La calidad de la sal no es uniforme sino varía según las diferentes capas, como ya lo hemos indicado anteriormente. La mejor clase de sal se encuentra en la cubierta superior de sal; un análisis hecho en el Instituto Geológico dió como resultado un contenido de 95 por ciento de cloruro de sodio; se trata, pues, de una magnífica sal bruta; un resultado igual había ya obtenido la primera expedición enviada por la Secretaría de Fomento (1) en el año de 1884.

	Por ciento.
Agua	5.16
Insoluble	5.19
Materia orgánica	1.14
Sulfato de calcio	7.14
Sulfato de magnesia	3.66
Cloruro de sodio	77.41
Suma	99.70

También esta sal constituiría, pues, una buena clase segunda de sal bruta. La sal de la cubierta superior necesita solamente ser molida para constituir una buena sal de cocina; la sal de las capas inferiores necesitaría una recristalización para hacer de ella una sal de cocina.

El modo de extracción y el transporte de la sal en realidad no son tan difíciles como parecen ser a primera vista. Para la extracción de la cubierta superior de la sal puede utilizarse el método de una especie de arado (scraper), lo que permite un trabajo barato y en gran escala. Las capas inferiores impuras se tendrían que sujetar a un sistema de recristalización, método muy simplificado aquí por la sequedad del aire. Un factor de mucha importancia para la explotación de las salinas lo constituye la solución saturada de sal que se encuentra dentro y debajo de la cubierta superior de la sal. La cantidad de esta solución existe en la actualidad no la podemos expresar en cifras, pues no hay datos para calcularla aunque fuera aproximadamente; lo único que podemos decir, es que la cantidad seguramente es enorme; no hay que olvidar tampoco que esta solución se reproduce constantemente por la entrada de las mareas altas en los senos cerrados. Esta solución se puede usar directamente para hacer cristalizar la sal en tanques; como ya lo hemos mencionado; la solución es tan saturada, que la cristalización empieza ya después de pocas horas cuando la solución se expone a la influencia del aire seco.

La dificultad principal para la explotación de las salinas es el mantenimiento de los trabajadores, pues todos los víveres, con excepción de la carne que se podría obtener de la sierra de Calamahía, etc., se tendrían que traer por mar de otras partes.

El transporte de la sal se tiene que hacer naturalmente, por medio de buques. Sabido es que durante unos diez años las salinas de Ojo de Liebre fueron explotadas por una Compañía clandestina; según los datos recogidos por la primera expedición enviada a la Baja California por la Secretaría de Fomento, aquella Compañía transportaba la sal en embarcaciones de 400 a 500 toneladas; para transbordar la carga desde el muelle a los buques fueron empleando lanchas hasta de 80 toneladas. Estos datos relativos a la posibilidad de la navegación de buques de 400 toneladas en la laguna de Ojo de Liebre, se confirman por las indicaciones de la Oficina Hidrográfica de los Estados Unidos en su publicación oficial.

Los gastos brutos de extracción de la sal serán seguramente muy bajos en comparación a otras salinas del país. Trabajando con arado (scraper) un hombre puede acumular en un día, según nuestro cálculo, cuatro toneladas de sal, de modo que diez trabajadores podrían producir 1,200 toneladas por mes o 14,400 toneladas en el año. El jornal no pasará en aquella región de 2 a 3 pesos; suponiendo un jornal de 2.50 pesos, los gastos brutos de extracción de aquellas.... 14,000 toneladas, ascenderían a 9,000 pesos (no descontando los domingos y días de fiesta) o sea por tonelada un gasto de 62 centavos. A estos gastos se tendrían que añadir los gastos de administración, descuento por demérito, interés del capital invertido, flete y en caso de exportación los derechos aduanales; estos gastos no los podemos calcular por faltarnos los datos exactos.

Para dar una idea del valor de la sal de Ojo de Liebre, citamos aquí los precios en algunas regiones. En California fué el precio por tonelada de 9 pesos mexicanos, según la estadística oficial del U. S. Geological Survey.

En Calamahí se calcula el valor de la tonelada de sal en 5 a 7 pesos, pero el consumo local es muy pequeño. El precio de la tonelada de sal en la capital de la República asciende a 35 pesos.

Para encontrar la capacidad de un cilindro en galones, multiplíquese el area en pulgadas por el largo de la carrera del pistón en pulgadas, con lo cual se obtendrá el número total de pulgadas cúbicas. Divídase esta cantidad por 231 (que es el contenido cúbico en pulgadas de un galón americano), y el cociente será la capacidad en galones.

Un pie cuadrado de parrilla consume, por término medio, doce libras de carbón por hora.

El consumo de cianuro varía de media libra a dos libras por cada tonelada de mineral tratado.

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(1) J. M. Ramos, Informe relativo a los trabajos ejecutados por la Comisión exploradora de la Baja California. An. d. Min. Fomento, t. VIII, 1887, p. 288.

Un análisis de las capas interiores de sal ejecutado igualmente en el Instituto Geológico Nacional, dió los resultados siguientes:

Condiciones Geológicas de la Región Norte de la Costa Occidental de la Baja California, México.

Un trabajo que se ocupa de los recursos naturales de un país, forzosamente tiene que dedicar un capítulo a la geología del terreno, es decir, a la composición y el origen del suelo que constituye la base estable de toda actividad económica.

Los terrenos de la zona estudiada por nosotros se componen por una parte, de rocas formadas en el mar, y por otra de rocas volcánicas. Las rocas sedimentarias de formación marina pertenecen a diferentes pisos y horizontes. El piso más antiguo encontrado por nosotros es en el Cretáceo medio. Este se compone de rocas muy diversas; en la región de la costa, su masa principal está formada por tobas porfíricas depositadas en el mar como lo prueba la existencia de fósiles marinos contenidos en estas tobas. En estas tobas están intercaladas corrientes de pórfidos y bancos de caliza que con frecuencia contienen también fósiles marinos, particularmente caprinidas.

Más hacia el interior se encuentra este mismo piso compuesto en parte de tobas y lavas porfíricas, y por otra de pizarras arcillosas con bancos de calizas. Allí donde estas rocas del Cretáceo medio están atravesadas por grandes masas de rocas intrusivas como granitos, dioritas, etc., las rocas sedimentarias han sufrido un metamorfismo muy fuerte, que cambia las pizarras y tobas en una especie de pizarras micáceas y las calizas en mármol más ó menos blanco; parte de la caliza se convierte en epidota. Las rocas de este piso tienen una distribución muy vasta; se encuentran casi en toda la región visitada por nosotros; generalmente un poco alejadas de la costa, pero de vez en cuando llegando hasta la orilla del mar. Así, por ejemplo, se encuentra este piso al Este de Tía Juana, en un gran tramo hasta el valle de las Palomas; forma la mayor parte de las montañas de la bahía de Ensenada y casi toda la sierra entre ésta y San Antonio del Mar. Además, lo hemos observado al Este de las mesas que se extienden entre San Antonio del Mar y San Quintín. Sigue hacia el Sur retirado del mar, al Este de las grandes mesas formando una amplia zona entre el Aguajito (al Este del Rosario) y la ex-misión de San Fernando, que queda casi en el centro de la Península. Esta misma zona continúa hacia el Sur en varios lugares interrumpida por otras formaciones, pasa por Santa Catarina, el rancho de Santa María, Punta Prieta hasta el Rosarito. Otra zona se encuentra más hacia el centro de la Península, al Sur de Punta Prieta, y es aquella que la encontramos cerca de Calamahí y Campo Alemán.

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* Parergones del Instituto Geológico de México.

El pórfido es de por sí una roca volcánica que no muestra estratificación, pero como sus corrientes de lava alternan con masas de tobas depositadas en el fondo del mar y con pizarras y calizas marinas, las montañas compuestas de las rocas de este piso, toman el carácter general de las rocas estratificadas. Las rocas de nuestro piso ya no forman en la actualidad una masa continua como al tiempo de su formación, sino que han sido levantadas por movimientos orogénicos, intrusiones de granito, etc., y constituyen ahora grandes sierras de crestas accidentadas y de determinada dirección; allí donde llegan hasta la orilla del mar, forman importantes cabos y puntas como lo hemos indicado ya en capítulos anteriores al hablar de la orografía y del carácter de las costas de nuestra zona.

Después de haber depositado las rocas del Cretáceo medio, hubo un período de enormes intrusiones y erupciones en el interior de la corteza terrestre. De estas rocas intrusivas es la más antigua la diorita, a ella siguió el granito, y las últimas fases de este período de intrusiones las representan los diques de aplita, pegmatita y de cuarzo, diques que están en conexión íntima con los granitos. Este período de intrusiones tuvo lugar inmediatamente después del Cretáceo medio, es decir, al principio del Cretáceo superior (Turoniano). Al atravesar las rocas del piso del Cretáceo medio, estas rocas intrusivas han producido fenómenos de un metamorfismo de contacto muy intensivo. Las pizarras y tobas perdieron su caracter primitivo y tomaban un aspecto semejante a aquel de las rocas paleozoicas y arcaicas, las calizas se cambiaban en mármoles y dolomitas, los fósiles se perdieron por completo o en parte o fueron convertidos en epidota, parte de las lavas y tobas porfíricas fueron silicificadas, otra parte fué refundida en el contacto con los granitos.

Las rocas intrusivas citadas aquí, se encuentran algunas veces en tramos limitados en contacto íntimo con los pórfidos descritos antes, pero otras veces forman enormes sierras en cuya composición otras rocas participan sólo de una manera secundaria. Estas grandes masas de diorita, granito, etc., se encuentran principalmente en el interior, donde constituyen las enormes sierras centrales, el espinazo de la Península. Así es que estas grandes masas se encuentran en su mayor parte fuera de la zona que fué estudiada por nosotros, con excepción de la parte meridional donde las hemos encontrado en las sierras entre la laguna de Chapala, San Borjas y Calamahí. En la zona de la costa del Pacífico observamos en generalidad sólo tramos poco extensos de granitos y dioritas, como por ejemplo, al Este de Tía Juana, cerca de Matenuco, Palo Florido y el Carrizo; al Este de la ex-misión de San Miguel, en el valle de Santa Rosa, en el de San Marcos y de San Antonio, en el centro de la bahía de Ensenada, etc. Más al Sur, encontramos una zona granítica de bastante extensión, pero sin que en ella se formen sierras muy considerables entre la ex-misión de San Fernando y Santa Catarina. Tramos más o menos reducidos de rocas graníticas los hallamos también en los alrededores del rancho de Santa María, del cañón de San José, en las inmediaciones de León Grande, Punta Prieta y Rosarito.

Durante el período de las intrusiones, grandes partes de la Península se habían levantado ya sobre el nivel del mar, pero su ancho, como su altura, era seguramente inferior al de la península actual. Sobre las rocas solidificadas del Cretáceo medio y de los granitos y dioritas, etc., comenzaron a depositarse las areniscas, margas, arcillas y calizas del Cretáceo superior (Senoniano). A consecuencia de esto los afloramientos del Cretáceo superior, se encuentran sólo en una zona que acompaña la costa y que raras veces se extiende algo tierra adentro. Tampoco este piso forma en la actualidad una zona continua sino que se encuentra en tramos con frecuencia interrumpidos por depósitos de rocas más antiguas. Así se encuentra una zona larga y casi continua entre la Mesa Redonda y la punta de San Miguel al Norte de Ensenada; otro tramo corto se halla en la Punta Banda al Sur de Ensenada. Una zona de un ancho variable se extiende casi sin interrupción desde el rancho de San Isidro hasta cerca de San Quintín; otra desde el Socorro (al Sur de San Quintín) hasta el Sur de punta de Canoas. Mas al Sur ya no hemos encontrado afloramientos del Cretáceo superior, pero es muy posible que se encuentre en tramos cortos en algunas partes de la costa que no fueron visitadas por nosotros.

Las rocas que componen este piso son, como ya lo hemos indicado antes, principalmente margas, pizarras arcillosas, areniscas y bancos de caliza. Todas estas rocas se encuentran muy bien estratificadas en lechos y bancos delgados. Las rocas no han sido plegadas sino que se encuentran todavía hoy en posición más o menos horizontal. Sólo en casos aislados observamos que las capas del Cretáceo superior están inclinadas, y sobre las causas que han producido esta posición hablaremos adelante, porque han dislocado también las rocas más modernas que se describirán posteriormente. Sobre la importancia que precisamente este piso tiene para la agricultura, hablaremos también en un capítulo parte.

Nuestro piso contiene casi en todas partes una gran cantidad de fósiles que permiten una determinación exacta de la edad. Las rocas del Cretáceo superior forman en conjunto con las rocas más modernas, las extensas mesas que acompañan en Baja California a la costa del Pacífico.

[Continuará.]

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Small Mines versus Large Enterprises.

Of late years there has been a tendency to glorify the huge mining enterprises, where thousands of tons of ore are handled daily and costs can be pared to the lowest possible notch, at the expense of the much more numerous operations which, although not so spectacular, after all must make up the bulk of the mining industry everywhere. The engineer who, backed by inexhaustible capital, successfully handles the largest tonnage ever taken care of in a single plant and pares off a fraction of a cent from the lowest record cost no doubt deserves all the praise and all the publicity he gets, but in our opinion the man who takes hold of a property of unknown and probably limited possibilities and who carefully adjusts the amount of capitalization to the possibilities and the expenditures for equipment to both, securing a good profit on his stockholders' investmen, merits quite as much credit, if not more. Moreover, from the point of view of the investor, it would seem that much more attention might be profitably devoted to smaller properties. There are a number of mining ventures in Mexico which usually are overlooked in enumerations of conspicuously successful enterprises and which, nevertheless, pay their stockholders comfortable dividends of 30 and 40 per cent per annum, while the great, highly advertised operations are compelled to do a lot of figuring before they can give their investors 10 or 15 per cent.

There is such a thing as carrying a good thing too far. Large tonnages and extremely low cost are attractive and also good economy, but the chief object of mining, as of every other business, is profits. When great tonneges are not to be had, and low cost are impossible it has been too readily believed that profits also are impossible. There is another factor which enters into mining for profit and that is the richness of the ore. There is only one Cananea in Mexico but there are thousands of little pockets in the country from which the Indians extract handfuls of rich ore. The Cananea engineers have developed an economy which has won the admiration of the world; the methods of the Indians, on the other hand, are crude and wasteful in the extreme. Between these two extremes lies a vast field for enterprise in legitimate mining, and in each enterprise there will be room for the excercise of a full measure of engineering ability, for in no case will it be possible to follow slavishly the methods of either Cananea or the Indians.

There is another way in which the influence of the great, ambitous mining operations has been too evident, and that is in the development of practice. So-called standard practice has been developed at the big properties, and imitation of the "big fellows," inherited from the days when all ores were either free-milling or smelting has unhappily not yet disappeared. Everybody now knows that because a mill did good work

in Guanajuato is no reason why that same mill will be satisfactory in Catorce. Now it so happens that the mines in Mexico which pay the greatest dividends proportional to their capital invested are not those which operate 1000-ton mills, nor 500-ton plants; those that pay from 30 to 100 per cent per annum are small affairs treating from 20 to 80 tons per day, enterprises which are commonly overlooked when it comes to summing up the trend of practice.

A reader of current metallurgical literature and not a wide and close observer would hesitate to pass by all the latest devices for handling slimes, including filters, pulpers, clarefyers and the like, and install instead the old Hobson agitating and decantation tank, no matter how limited might be the resources of his company. Yet tanks of this kind, with their slow and discontinuous action, are at the present writing being installed in one of the so-called minor operations of the country, and will without a doubt prove highly satisfactory. Items of supervision, repairs, labor and efficiency all acquire a different angle of perspective when adjusted to small-scale operations. It will pay the engineer, and especially the young engineer, to study more carefully the smaller plants.

Last, but not least, in this consideration of the neglect of small properties, is the effect upon the personnel of the mining business. Other things being equal, it is better for a country to have a hundred small mines in operation than one great one, provided that they pay a fair average profit. Deposits capable of yielding immense tonnages are limited in number, and will grow fewer as time goes on. If the idea prevails that only immense, uniform orebodies can be worked with any promises of succeess, there will be no mines to take the places of the "big fellows" when the present great deposits become exhausted.

A Complete Testing Laboratory for the Esperanza Mine.

Some months ago we remarked in these pages that Mexico had not a single well equipped laboratory for testing ores and processes. This reproach is now to be removed. The Esperanza mining company of El Oro is perfecting plans for a testing laboratory which should be as complete as possible, for the company is inclined to spare neither trouble nor expense to make it capable of serving every purpose to which it may be put. There will be apparatus for investigating the crushing of ores, concentration, extraction with cyanide solution under varying conditions and even flotation as applied to ores carrying gold and silver. Besides these special appliances there will be all necessary apparatus for making the usual, routine tests with provisions for the use of air, power, etc.

Although situated in a standard camp and possessing a standard mill, this company, it seems, is not satisfied with present and past performance, but wishes to do better. This attitude is refreshing at a time when most mining men are regretfully contemplating the achievements of the past, and when any suggestion that anything might be better than conditions, including metallurgical practice, as they were in pre-revolutionary days, is looked upon as heresy.

The American Society of Mexico.

The officers of this society of and for Americans are still busy gathering information which they are storing or placing where it will do the most good. Unfortunately much of the work now being done does not appear above the surface and cannot become evident until some power provides facilities for communication with the rest of the country. For this reason the members at large must still wait, with such patience as is theirs to command, for news as to what the society is doing in their behalf.

One part of the program will necessarily fall to the members themselvs, for no one can do this for them, and that is the registration of their names. Steps are under consideration for facilitating and hastening this registry, but at the present writing nothing definite has as yet been decided upon. In the mean time, every American in Mexico should do what he or she can to place his or her name on record somewhere, so that the names may be found with the least expenditure of time.

Handling Corrosive Solutions.

The development of roasting and leaching processes has brought to light a whole series of difficulties in the handling of corrosive liquids and gases in large volumes. In the manufacture of chemicals, appliances for handling acids and other compounds which attack the ordinary materials of construction, have been developed from necessity, and in that industry this part of the work has long since been reduced to a regular, accepted routine. In the manipulation of individual chemicals it has usually been possible to find some one material which resists that particular compound. Thus, lead is sufficiently proof against the corrosion of sulphuric acid to make this metal useful for various purposes in the manufacture of this acid, and certain strengths of sulphuric acid may be safely stored in iron tanks. In chemical works the volumes handled are also commonly so small that it is possible to employ earthenware, porcelain and glass containers.

In leaching with acid liquors on a large scale the practice which is satisfactory in chemical works is in many ways out of the question. In some of the roasting and leaching processes, using solutions made from salt and condensed roaster gases, the liquors contain all sorts of acid combinations of chlorine and sulphur compounds, dissolving not one metal but whole series of metals. Some of the rich solutions from leaching after the chloridizing roast contain silver, copper, lead, zinc, iron and other metals. Obviously with solutions of this kind it is impossible to use fittings of iron or the common and even special alloys. In a case like this the engineer can not depend upon machinery catalogues for help. He must resort to his own ingenuity.

At the Mines Operating Co.'s plant at Park City, Utah, much careful attention has been given to these difficulties. Leaching is there carried on in wooden tanks of Douglas fir. The wood is not affected by the mill solution, but constant care must be exercised to

prevent dripping on the iron bands of the tank. Stave pipe of the same wood is employed to conduct the solution to and from the leaching tanks. Instead of valves a section of rubber hose fitted with an iron screw clamps is used. For connection the hose is clamped with an ordinary brass clamp or a hardwood nipple, fitting into the wooden pipe. No wooden launders can be used for carrying mill solution, concrete launders being used instead. The nails or screws in launders of wood are soon destroyed, and the substitution of brass or copper nails does no good, for the silver in the solution replaces copper. Filters made of wood and burlap were used for several months, but these were discarded in favor of perforated drain pipe set in concrete, exposing the perforated side. The silver is precipitated on scrap copper, and instead of precipitation boxes of the usual form an inclined plane surface of concrete is used. Clean-up is effected by means of a hose for sluicing the precipitate into a tank, the scrap copper being raked over with hoes and brooms.

At this plant pumping solutions carrying silver and copper proved to be a difficult problem. Centrifugal pumps of bronze lost their casing in 40 hours of continous use, the failure being due to replacement by silver rather that corrosion by acid. Cornish pumps and plunger pumps of wood were tried, but both needed excessive repairs. The problem was finally solved by the adoption of air-lifts of woodstave pipe, fitted with large wooden elbows and tees, the air being introduced through a rubber hose. Three of these air lifts handle from 1000 to 1500 tons of solution per 24 hours. Suction fans for roaster gases was another problem. Fans with iron and brass runners were discarded, and a fan made entirely of hardwood held together by means of wooden pins did good work for six weeks, when the wood softened and the runner was wrecked by centrifugal force. A fairly satisfactory fan was later constructed, the casing being of heavy wood and the iron blades covered with rubber gasketing, the shafting and other heavy iron parts being covered with concrete.

The metallurgists at this plant seem to have evolved a complicated set of processes, and to have devised a full set of machinery as well.

Cost of Producing Copper.

An interesting comparison may be drawn in regard to tonnage, metal content of ore and cost of producing copper from the reports covering the last three months of 1914 as issued by a group of large companies operating on so-called disemminated copper ore. The reports most readily available are those of the Utah Copper Co., the Nevada Consolidated Copper Co., the Chino Copper Co., and the Ray Consolidated Copper Co. During the period covered, all of the companies were operating at reduced capacity, yet in no case did the average cost of producing a pound of copper rise above the lowest market price quotations recorded during those months.

Of the group, Utah Copper has the greatest output, 20,229,012 pounds, slightly more than half capacity, the lowest grade of ore milled, 1.5062 per cent, and the lowest percentage extraction, 64.86 per cent. Yet its cost per pound of copper, 7.731 cents, is below the cost per pound reported by the Chino Consolidated, 8.14 cents, and the latter company milled the richest ore of the group, having an average of 1.8612 per cent copper, and the best extraction, 69.14 per cent. The difference in cost seems to correspond with the difference in tonnage handled, the output of Chino, 8,935,585 lb. being less than half that of the Utah company. Yet the operations of the Chino can hardly be said to be on a small scale, for during the period in question it milled 3774 tons per day, and during the first quarter of the same year, when times were more nearly normal, its daily tonnage averaged 6469 tons of ore.

The Nevada Consolidated and the Ray Consolidated produced during the same period 8,056,236 and 9,563,-113 pounds of copper respectively, the average percentage of metal being for the former 1.54 per cent and for the latter, 1.74 per cent. The net cost per pound of copper was 8.42 cents and 8.74 cents respectively. The average mill recovery for the Ray Consolidated was 68.2 per cent, milling costs 54.56 cents per ton and mining costs 49.722 cents per ton.

It is, of course, impossible to tell how these costs were calculated or which items were included and which omitted. It is significant that although in each case there was a good margin between the net cost of copper and the market price, it was still necessary in the case of two of the companies to declare a deficit for the period.

Flotation and Copper.

The adoption of flotation in the copper concentration camps now threatens to change the entire system of treatment, which had almost become standardized. It is another illustration of the interdependence of all things mundane. Darwin once showed how the farmer's clover crop might depend directly upon the number of hawks and other birds of prey in the neighborhood. It there were many hawks, there would be few field mice; if there were few mice to raid the bumble-bees nests there would be an abundance of bumble-bees to fertilize the clover flowers, a good crop of clover seed, etc., etc.

Because the blast furnace has been used for smelting the copper concentrates, coarse crushing has been the rule and a large proportion of fines feared like the pestilence. Reverberatory smelting can now be conducted as cheaply as blast furnace smelting. The reverberatory can handle fine material as readily as coarse, hence there is no longer a necessity for coarse concentration. Hitherto the concentration of the finer sizes of the ore has been difficult and unsatisfactory. Flotation works best on very fine slimes. Hence the interdependence of the coal-fired reverberatory and the flotation process, and the threatened elimination of the blast furnaces and the vast installation for crushing without sliming.

Colonel Tepetate.

The Colonel looked particularly fit that morning. His step was brisk and the famine was evidently very far from touching his physical well-being. He did not try to avoid the Pessimist, whom he saw approaching. Contrary to his attitude of the past few months he seemed glad to see him.

"Well? Looks a little brighter, doesn't it? But then, I can't expect you to admit it."

"I'm from Missouri. I've got to be shown, "replied the Pessimist with an assumed layer of gloom.

"What have you got to be shown?"

"This peace and prosperity you're always promising."

"Oho! I've been promising that, have I? You talk just as though I were keeping something from you to which you have an inalienable right. I have'nt got your peace and prosperity stuck away in my coat tail pocket. Who promised you peace and prosperity, anyhow? Go and ask them for it. Do you know what you'd do if your peace and prosperity were handed to you on a gold platter this minute? You'd look at it from all sides, turn it over, look glummer than ever and kick because it wasn't a bigger piece."

"Anybody who has enterprise enough to invest his good money and build up a business has a right to expect freedom to—"

"Yes, I know, "remarked the old man soothingly," and pretty much the whole world is fighting because everybody thinks his slice of that 'freedom to' isn't big enough."

"The world is crazy."

"Sure! But not much more so than usual. It's a vale of tears and a pretty bum place if you look at it from that angle. Just the same the sky is mighty blue this morning, and look at those tints of green against that white cloud."

"Humph! "grunted the Pessimist." You and your optimism make me tired. Here you have been predicting improvement for the past year, and you haven't been right one single time."

"True, "admitted the old man." The pessimist is right nine times out of ten. That's why he seems so wise when compared with the fellow who is always boosting. But it's a cheap wisdom. It doesn't get him any where. Every time he is right he is worse off than he was before and all he's got to show for it is 'Ah! I told you so'. Some day I'll be right and then everybody will be better for it."

"In the mean time what does it get you?"

"For one thing a good digestion. And it keeps me in shape to go ahead when I get the chance again."

"What do you mean?"

"I mean this."—Do you think, have you ever thought, that this thing will be permanent?"

"No-o, "admitted the Pessimist reluctantly. "It can't very well go on forever."

"Do you expect to see the end of it?"

"If I didn't I'd get out of here before the walking gets worse."

"Exactly! The worst of them will admit that much when you get them into a corner. They know they are going to take their medicine, but they want the privilege of howling and whining about it. And the worst howlers are the fellows who are drawing a good salary in gold from some longheaded firm back in the States. They've enjoyed fat and prosperity for years, and now they insist on telling their backers back home that things are everlastingly going to the bow-wows. They actually expect those who pay them the salary to cheer them up besides. Some who are here to look after capital invested, run away at the slightest flurry, leaving their employers' interests to the mercies of the winds that blow, and expect to do their kicking and draw their salaries in more agreeable surroundings. Do you know what I'd do if I were a millonaire and had a hired man like that?"

"Make him stay on the job, I suppose."

"No. I'd kick him out of his leather-backed chair with the biggest boot I could find. Some of the worst howlers are what they are because they have nice little wives at home. When one of these big boobies goes to his comfortable slippers at night, he growls about things growing worse and worse, and the poor little thing, who really has something to worry about, pats him on the back, and coos to him that it will all be better soon. The when he goes to the club and swears because highballs are a dollar apiece, he is sore because his friends won't do the same kind of patting on the back and cooing."

"Oh! Of course, if you want to listen to all sorts of gossip" sneered the Pessimist, not quite at his ease.

"Some of these folks have worked themselves into such a state," went on the old man, seeming not to notice the interruption, "that they will be positively miserable when things do come right again."

"No such luck. It won't be so fine."

"There'll always be enough to kick about, of course. But think of the fellows who have had nothing to do but whine about their fate, fourteen hours a day, and who had an idea that it was their duty to dig up every horrible thing that might possibly happen to them. How are they going to hold down a job after it is all over? Howling about something you can't help is a poor attitude for holding down a job. What are some of these agents in the city going to do when orders again begin to come in? I can fancy one of them beginning a letter something like this: 'Dear Sir: Conditions are daily growing worse. Railway communications—'Then he'll wake up and try to work that into a real letter so as not to waste a sheet of paper. You see, habit is a terrible thing, and it pays to watch the habits of mind as well as the other sort. Almost every house has windows to the south as well as to the north. You can take your choice as to which you prefer to look out of. The southern exposure is the only one that pays. Everybody is shy of the fellow who always looks north through a tunnel."

"It is easy for some people to talk."

The Colonel held up a warning hand. "I am eating my own tortillas, "he said. "and I take my medicine like the rest of you. If I sometimes feel like making a face over it, I go into my own woodshed to do it."

An Alternating Current Rectifier for Metallurgical Laboratories.

Written for the Mexican Mining Journal.
By Paul W. Avery[1] and Angel O. Ulloa.[2]

In many metallurgical testing laboratories direct current for precipitation and regeneration tests etc., is sometimes necessary. Having had occasion to study the effect of electricity in the cyanidation of certain ores here at Esperanza and having only alternating current available, the authors built a small three cell unit following in essential detail the work of Messrs Haller and Cunningham in their description of the Tesla High Frequency Coil.

The cell has proven a decided success and a short description will be given here with the hope that where alternating current only is available, this cheap and simple rectifier will be found very useful. The majority of the rectifiers in use utilize the principle of choking out one half of the alternating current wave and for this reason their efficiency is very low. This rectifier, on the other hand, utilizes both halves of the alternating current wave, changing all negative values to positive and thus giving exceedingly high efficiency (possibly over 95 per cent) while the other above mentioned gives about 50 per cent or less.

The cells containing the unit may be of glass or any other insulating material. We had our cells made of fire clay by natives who make assay muffles and crucibles of the same material. These three cells are all 8″×6″×4″ inside measurement. The aluminum plates are cut of C. P. aluminum one eighth of an inch thick and are all the same size and shape. Four such plates are necessary of 5″×7″. If sheet aluminum of this thickness cannot be obtained two or more thinner sheets may be fastened together to obtain the same thickness. The plates are fastened together by thin strips of some hard insulating substance, such as hard rubber, horn fiber etc. They are held a little less than a half inch apart and the strips need only be placed at the top. These strips should be a little longer than the outside lengths of the cells so they may serve as supports for the plates.

The best electrolyte for this cell is a saturated solution of bicarbonate of soda, as it does not attack the aluminum to any appreciable extent either during the period of work or idleness. A little transformer oil poured on the surface of each cell will lessen evaporation, and the troublesome creeping of salts.

The diagram given below will show how the cells should be connected up, care must be taken that it is not deviated from. When the rectifier is ready for the initial passage of current, extra heavy fuses should be placed in the A. C. 110 V circuit as an excessive current will be required to produce the oxide of aluminum coat which is essential to make the rectifier a success. After the coat has been formed very little current will enter the cells when the D. C. side is open. About 20 amperes may be taken from the D. C. side for about a half hour without any appreciable heating of the electrolyte. Water Coils of glass should be placed in each cell and connected with a low pressure water line. By keeping the electrolyte cool in this manner

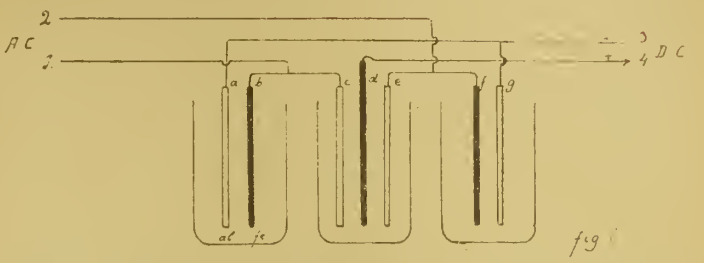

fig 1

higher efficiency is secured and the operator may run his cells as long as he desires.

Let us consider what takes place within the rectifier. Considering one cell only:

An oxide film forms itself on the aluminum plate after the current has been flowing through it for a few minutes. This oxide film does not affect the difference of potential across the cell; but prevents the ions from giving up their charge. The aluminum being the anode, a condition of enormous resistance exists, similar to that of a polarized copper plate in a single galvanic cell. On the contrary, when the wave of the other kind comes along ,that is, when the aluminum plate is the kathode by the reversal of the current, the resistance is reduced to that of the electrolyte and therefore we have what is called an asymetric cell.

Looking at the figure we see that when line No. 1 is positive, current flows from b and c towards a and d. Path c to d is of very high resistance, the aluminum being the anode; path b to a is of low resistance and so the current flows in this direction. When line No. 2 is positive current can flow from f to g or from e to d, but as the path from f to g is of lower resistance than that from e to d the current takes the former.

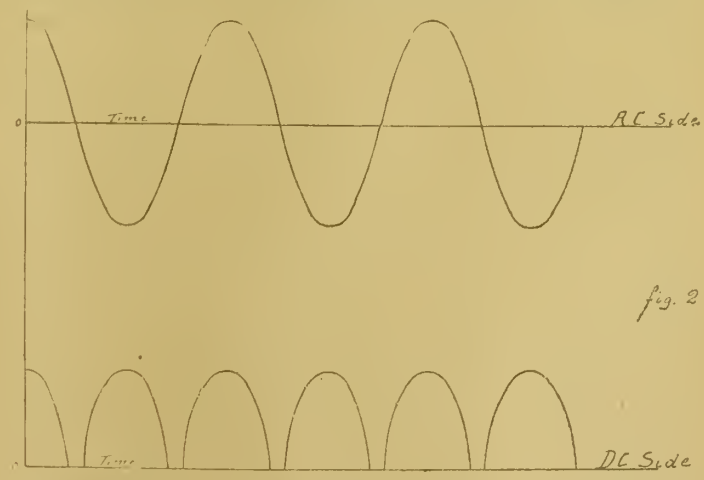

fig. 2

The curve of the rectifier may be represented something like the following Fig. No. 2. It would be a sine curve if the source of alternating current were a sine curve, a thing that almost never happens commercially. But, supposing, that the A. C. gave a curve as in the sketch, the rectified current would give the corresponding one below. This of course is not a direct current, but we might call it a pulsating "uni-directional" current, which will behave in electrolytic action as the direct current.

[1] Metallurgical Engineer El Oro, Mexico.
[2] Electrical Engineer El Oro, Mexico.

Mines of Ajuchitlan, Querétaro.

By Samuel J. Lewis.

The mines of Ajuchitlán are situated in the district of Tolimán, State of Querétaro, Mexico, about 25 miles northeast of Bernal station on the National railway, and a little more from the Central. They are reached by coach over good roads from Tequisquiapam, the little town near the railroad. The country generally is a level plateau about 6000 ft. above sea level traversed at considerable intervals by ranges of rolling hills with a general east and west axis. From the mines, the mountains of El Oro are in sight, about 65 miles to the southeast.

The principal mines, worked by the Ajuchitlan Mining & Milling Co. of Monterrey, are near the head of a gently sloping arroyo with rather steep sides, the latter due to the bluffs of andesite-capping overlying the steeply tilted shales. These latter form the country rock, and strike generally northeast, with a dip varying from 50° to vertical. Erosion has been active. The shales are exposed below the capping for at least 1800 ft., and the andesite itself is deeply pitted. Silica nodules have been left comparatively unaffected on the surface, while the surrounding feldspar has been cut away. Cooling cracks in the capping are abundant on the tops of the bluffs.

The local uplift containing the mineral veins is practically a single widely extended, many-spurred mountain, striking northwest, and evidently close to one edge of the great andesite flow that once covered hundreds of square miles in this country. Beyond this mountain, to the northeast, is visible but one important vestige of capping, the solitary butte known as the Peña de Bernal. This is a remarkable structure. The upper pyramidal portion, vertically scored with marks resembling flow-lines, is of soft red andesite, resting unconformably upon darker, more bluish andesite, the latter presenting the appearance of being straified; the planes have a dip of 45° southwest. The same stratified appearance occurs near the top of the Ajuchitlán mountain, on the side facing the Peña. It is probably due to slow cooling and consequent more perfect crystallization. The rock of the pyramid is identical with the red andesite found on the crown of the main hill and scattered over the slopes above the 250-metre contour. Below this level a much harder, more compact bluish andesite is found all over the ridges, giving a ringing sound when struck. The difference in the two kinds is so marked as to suggest two successive flows. The lower andesite of the Peña can be followed westward down into the arroyo, disappearing under vertically dipping shales, evidently much vulcanized. Detailed study might quite probably show the Peña to be the northeasterly limit of the capping.
activity. To the north of the butte, a few hundred metres, appear low red bluffs of the same upper andesite, apparently capping brown shales. This seems to be the northeasterly limit of the capping.

Old Workings.

As the shales are followed down to the bottom of the arroyo they become soft and brittle, and undergo startling changes in color through every shade of gray, black, brown, and red. About 500 metres north of the Peña, near the Chica Roma arroyo, the confusion of dips is so great through all angles to 90°, principally near the latter, that the immediate neighborhood of a centre of disturbances is at once suggested. Near the bottom of this arroyo is the only place in the district where the basal limestone is exposed upon which the shales were laid down. It lies with a dip of about 25° to the southeast, the shales above it being only about 250 ft. thick. It is a dense, fine-grained, hard blue limestone, traversed where exposed in the arroyo by innumerable calcite veinlets. Old workings in the hill at this point, going north, penetrate the same limestone with the dip unchanged, at 20 metres distance. It is probable that the original mountain crest was here, before the overflow covered the country.

On the west side of the main hill the mines of Ajuchitlan, one above the other, closely follow the dip of the vein-system. The large upper dump, to the north, marks the old Santo Tomas mine, the original discovery found and worked by the Spaniards. Remains of their old arrastres are stilll to be found in the arroyo, and some of their characteristic narrow low workings are intact in the mine. At this point the deposit is a flat 'blanket' going into the hill at about 15° for a distance of about 200 metres. Both the early owners and their Mexican successors gophered around in it looking for rich pockets, never getting very far from the surface. Nearly everything shown by the labyrinth of old workings averages $8 to $9 United States currency in value, consisting of about 60 per cent gold, the rest being silver. The highgrade pockets were exceedingly rich. In 1901 the Mexican owners sold the property to an American company. Development has been in progress since, coincidently with the building and operation of a cyanide mill.

Present Mine.

The new owners left the old mine, after about two years' study, and began work on the quartz outcrops below it. This has developed very large orebodies, containing ore of satisfactory value. Below it is the mouth of the lower level, used entirely for tramming ore to the mill.

The upper level, 41 metres in elevation below Santo Tomás, opened up the so-called Calavera vein, and led into what seems to be its intersection with the Santo Niño. The resulting orebody was large, and averaged about $8 U. S. currency in assay value. Here the first fault was encountered, relatively minor disturbance, which threw the vein slightly to the west; this being related to an igneous intrusion to be described later. Assay values in the immediate neighborhood of the fault rose to $25 and more.

Beyond, as work proceeded, two similar faults were encountered, with a like effect on the content and showing the same proximity to the igneous dike mentioned. From an assay value of $2 or $3 or less on the outcrop, the grade of the ore has risen steadily to about $8 in the Santo Niño vein and thence with slight variations to an average of $12, maintained now for over a year. At but one of the faults, the last, was the throw sufficient to make the picking up of the vein difficult. For the most part it has averaged a width of 9 metres. Both walls are usually well defined as highly calcerous shales dipping about 50° to the east; the foot-wall is overlaid by a few inches of barren quartz, below which is sometimes found iron-stained limy material. A similar iron-stained breccia is found

* Abstract of an article in Mining and Scientific Press.

next to the hanging wall, and gives high assay values occasionally. A rich stringer follows through it, re-appearing at intervals. Near the present face the foot-wall is as smooth as masonry for many metres. At other points it blends into the country.

The ore has been blocked for about 50 metres above this level, and connection has been made through barren shales with the old mine. Below the level, ore-chutes and air-connections have been carried down on the vein 55 metres in vertical distance to the level of the lower drift. This, begun after the new mine was opened, is in ore except for the first 100 metres, which pass through drift and shale, cutting the vein in the foot-wall. The total length of the level is now about 650 metres, practically all driven by hand.

The Ores.

The grade of ore found here varies from $4 to $6, with unmistakable signs of downward leaching and secondary enrichment. Sinking has been begun near the face, following down on the vein, to reach a zone of secondary enrichment. The indications are favorable that this will be found, judging from conditions at the neighboring prospect known as the San José. The prospect, which is of great interest, lies about 900 metres to the south of the Ajuchitlan mines and lower by 42 metres at its shaft collar than the level of the lower drift. The property is small, entirely developed by an 80-metre shaft in the hanging wall. After cutting the vein at about 55 metres, water became troublesome and now fills the lowest 15 metres of the mine.

Two main drifts on the vein-system at different levels have developed about 110 metres of mineralization, striking N. 60° E. Two cross-cuts totalling 40 metres, on opposite sides of the lower level, are entirely in mineralized shales, with the hanging wall well exposed and the foot-wall not yet reached. It is visible only near the mouth of the prospect, as unaltered brecciated brownish shales. Those of the hanging wall are blue, thicker, and harder. The assay values average about $3 throughout the orebody till the neighborhood of the shaft is reached, when there are sporadic but recurrent rises to $7 in value. Near the bottom of the shaft considerable $18 and $20 ore has been found, on which a small and inefficient mill was run till financial difficulties paralyzed the operations.

The notable size of this block of mineral, totalling probably half a million tons, in such a small space, with the permanent water found, indicates a drainage system of considerable extent.

The parallel layers of altered shales, slightly separated by bands of quartz, are characteristic of the orebody throughout the prospect. In general features, the property is closely allied to the Ajuchitlan vein-system. The only essential structural difference is in the degree of disturbance suffered here when the original water-channels formed. The latter mines seem to have been close to the centre of uplift, the fracture forming a fissure of some size, in places quite open.

The ore formed here is in relatively concentrated form. In the San Jose, farther from the uplift, there seems to have been merely a loosening of the shales along their stratification planes, over a considerable area. Ore-bearing solutions percolating through mineralized loosened shales depositing occasional higher-grade pockets; and meteoric waters have since leached the upper portions of the vein to enrich the lower. Since the erosion of the andesite capping, leaching of this vein has certainly proceeded rapidly.

Two shafts sunk in the arroyo by the Ajuchitlan company in search of water for milling purposes, supplement this evidence. Both were successful, and from one of them, near the San Jose ground, all the water is pumped for the 65-ton mill and about 500 employees. The conditions seem to indicate continuance in considerable depth for both properties. The workings in the new mines of the Ajuchitlán company have developed about 250,000 tons of ore with assay values from $7 to $12.

Origin of Orebodies.

The original orebodies seem to have been formed by an uplift which fractured the shales along the line of the present veins; the shales on the opposite sides of the mountain indicate this also by their dip. The tearing apart of the strata was accompained by much vertical oscillation, as shown by the crushed condition of most of the vein.

Study of specimens at once establishes the presence of the two factors, movement and water. The whole is cemented by a lime-silica deposit. Occasional small but perfect quartz crystals in open cavities are found. Banded structure, due to successive depositions is shown, the dark bands being rich sulphides of silver, containing gold; the white between being quartz. Through the sulphide bands pass minute veinlets of green iodo-bromides of silver, where oxidation has proceeded. The vein as a whole is thorougly oxidized, the residual sulphide nodules showing as black specks. Some fine specimens of bromargyrite have been found here, practically all the silver being in this form. Chlorides are rare, occurring only as small isolated crystals.

The extraordinary condition of the orebody in the Santo Tomas mine has made the problem of origin difficult. The thick sheet of ore found there, nearly horizontal, capped by shales, and in places horizontally parted by strata of shale, ends abruptly in the country rock, and seems a body independent of all others. The important developments which brought it into relationship with the main vein system were two: a cross-cut northeast through the barren shales from the apparent end of the 'blanket,' meeting the vein of the new mines at about 40 metres distance, and a drift in ore, near the northern end of the 'blanket,' which follows the deposit uninterruptedly through a change from the horizontal to the normal dip of the main vein and into it.

These facts establish the Santo Tomas orebody as an immense dislocated fragment of the original vein, torn bodily from the parent structure at the southern end, and moved about an axis near the northern. The shales overlying the blanket could only have come from the former hanging wall of the structure. Overhead winzes pass through them to daylight, and in the further parts of the orebody reach the broken and decomposed bottom of the andesite capping. Slickensides abound, with every angle of dip. The ore in the Santo Tomas is much decomposed as if by action of water. Great brecciation of both shales and ores is found, most conspicuous in the immediate neighborhood of the parent vein. The whole orebody is out of place, and originally occupied a position fairly coincident with the vein as later developed. The origin of the dislocation is in the igneous intrusion previously alluded to, which will now be described.

The rock in fracture shows a coarse ground-mass of feldspars in which are plentifully embedded beads of unaltered glass, averaging $^1/_{16}$ to $\frac{1}{8}$ in. diam. It is found as abundant 'float' on the surface along the west slope of the spur, as shown; never on the low ridges closing the mouth of the valley nor above the level of the Santo Tomas. Underground, it has been cross-cut in workings driven east from the vein, in the new mine, and as a capping in the inner workings of the old. In all cases, its presence in the new mine has accompanied slight displacement of the vein westward. In the case

of the first fault, the rhyolite came in as a horizontal fold or nose, which pushed the vein westward to correspond. As the nose receded eastward, assuming its general dip, of about 60° northeast, the vein also recovered its normal dip.

The dike seems to have come upward and outward from somewhere near the Peña de Bernal, paralleling the vein for some distance, and finally cutting across it completely. In the upper tunnel and drifts below it, the workings have clearly defined it at several points as curving round in a northwesterly direction. The vein is completely cut off, the contact being strongly slickensided and striated; on the other side, the drift is in a conglomerate of andesite fragments and boulders.

About 30 metres have been driven on the general strike of the vein, and fragments of quartz containing payable silver and gold are being found. The vein should be picked up with little further driving, probably will be, but little dislocated. Where encountered in the workings, some 15 metres below this point, no andesite fragments whatever appear. The dike cuts across at about N. 80° W., the vein being much broken and discolored for about 5 metres south. Beyond, fragments of ore and quartz clearly indicate the proximity of the unaltered vein, and help to explain the nature of the obstruction above.

Structural Changes.

Study of the surface above the face shows a slip in the capping along a line about N. 70° W., closely corresponding in direction and location with the line of the dike below. The slip is local, confined entirely to what is now a little hollow behind the rugged andesite bluff above the mines.

The entire absence of rhyolite fragments from the surface of the capping, of itself indicates that the dike antedated the latter. It seems clear that the igneous intrusion came to the original surface, becoming itself a channel for the circulation of meteoric waters, which in conjuntion with the grinding and settling along the walls of the crack, produced the rounded pieces of rhyolite we find in it today, embedded in damp clayey gouge. A unique piece of rhyolite found on the surface shows complete replacement of the groundmass by hard smooth ivory-white quartz, banded in concentric layers, with the gas bubbles intact. The andesite flow, conforming to the topography at that time, deposited a thin sheet over the present arroyo, then the ridge, and filled more deeply the hollow places above the present vein system.

Once the thin sheet of andesite was broken, erosion on the soft shales must have been rapid and destructive, carving out the present valley and causing blocks of the capping to split off and fall as it became undermined. The process can be seen going on today, leaving cave-like openings at the foot of the bluffs. When the gradual advance of the erosive agencies reached the zone that had been fractured by the dike below the capping, a line of weakness developed along its course. The abrupt fall of a relatively large portion, taking with it vein, shales, and dike, with the original surface drift, could be only a matter of time. All the physical peculiarities of the zone clear up when referred to this slip. At the same time, there is observed on the present surface a large block of andesite which from the angles of its parting planes and its tilt is certainly not in place.

Tube-mill crushing capacity at the Consolidated Gold Fields plants on the Rand has been increased by means of a scoop discharge at the outlet end, which lowers the level of the pulp in the mill.

Aluminum Ore.

The price of aluminum is higher than that of copper, so it is perhaps natural that the prospector should think that 5 per cent of aluminum in a rock would make it valuable as an aluminum ore, since 5 per cent. copper would make it valuable as a copper ore. As a matter of fact, however, aluminum is the commonest metal in the world and is present in the average rock to an extent of 7.84 per cent. It is apparent from this that if ore containing 5 per cent of aluminum were of value for the extraction of aluminum, most of the rocks on the earth's surface would constitute aluminum ores.

The high value of aluminum is not due to a scarcity of that metal says the Mackey School of Mines Bulletin, but due to the difficulty of extraction. Ordinary clay contains a high percentage, ranging from 5 per cent. in sandy brick clay to 39.8 per cent in the pure clay mineral, kaolinite. But although methods exist of extracting aluminum from clay, the cost of such extraction is so high as to be at present prohibitive, although there is a strong possibility that some recent methods may prove cheaper and become of commercial importance. The minerals which are in use for the extraction of aluminum at the present time and the percentage of the metal which they contain are as follows:

Corundum—Al_2O_3—oxide of aluminum, 53.3 per cent aluminum.

Cryolite—AlF_3 3NaF—fluoride of aluminum and sodium 12.8 per cent aluminum.

Bauxite—$Al_2O(OH_4)$—hydrated aluminum oxide—39.13 per cent aluminum.

Gibbsite—$Al(OH_3)$—hydrated aluminum oxide; 34.6 per cent aluminum.

Of these ores corundum is so rare and so hard that is is more valuable as an abrasive than for its aluminum content. Before the discovery of bauxite, cryolite from Greenland was the chief source of aluminum. Bauxite was discovered in Baux, France, but has since been found in large quantities in the United States. It occurs in Georgia, Arkansas, Tennesseee, and New Mexico. Small amounts of gibbsite are sometimes associated with it. Commercial bauxite contains from 21 per cent to 34 per cent metallic aluminum. It is used not only for the extraction of aluminum, but also for the manufacture of aluminum salts, of alundum, (or artificial corundum), and of bauxite brick, (which are used as the lining of basic open hearth steel furnaces).

The production of bauxite in the United Sstates in 1913 was 210,241 long tons valued at $997,598, so that the average price per ton was $4.75.

Frank L. Hess proposes as a working hypothesis for the origin of the main carnotite deposits of Utah and Colorado that in the breaking down of veins, since eroded away, the sulphuric acid formed through the oxidation of pyrite and other sulphides, combined with uranium, vanadium ,copper, silver, iron and possibly chromium minerals of the vein to form sulphates which were carried into the shallow sea which existed during La Plata and St. Elmo geological time, and were there diffused and brought into contact with decaying organic matter by which the sulphates were reduced, the uranium possibly as an oxide or to a combined sulphide with vanadium or copper or both and the vanadium, copper, silver and iron to sulphides. Upon lifting, draining and aerating of the rocks the minerals were oxidized and part of the vanadium formed vanadic acid, which combined with uranium and potassium or calcium to form carnotite or tyuyamunite.

The Mineral Resources of Sonora.*

By F. J. H. Merrill.

Sonora covers an area of 77,000 square miles ,all of which is highly mineralized. Deposits of gold, silver, and copper occur in remarkable abundance and, under modern management, many have developed great commercial importance, while hundreds remained unworked since their abandonment during the revolution against Spain from 1810 to 1821.

In silver production, during the Spanish occupation, it was surpassed by some of the interior States, and none of its mines have equalled the great producers of the central plateau, but from the beginning it has been, as it still is, the chief producer of gold and is also first in production of copper. Long before the Spaniard came, in 1521, the natives had developed primitive methods in mining and metallurgy, which gave them large quantities of precious metal, and copper or bronze implements were in use; but to what extent they conducted underground work is not known.

Sonora is pitted and honeycombed with abandoned shafts, open cuts, and underground workings which are now called "antiguas," the term probably referring to all mining done before the revolt against Spain in 1810. In the clear atmosphere, on the treeless hills and mountains, the traveler sees everywhere the openings of the old workings that record the mining industry of the early days. In this climate of small rainfall and slow erosion the gradual decay of vein-stones and impregnated rocks, wherever exposed,resulted in rich surface accumulations of precious metal, especially near the exposures of gold bearing veins and, in these detrial deposits or placers, the first miners reaped a rich and easy harvest. Later, under Spanish rule, the introduction of the "arrastre," the use of quicksilver and various technical devices, gave the miner control of a larger field of action and new sources of profit.

Practically no machinery, however, was used in mining, and the notched log or 'chicken ladder' with the rawhide bucket on the back of the "peon" was the primitve substitute for modern hoisting and pumping machinery. So, also, the slow boring of shallow holes and the breaking down of the ore by the expansion of quicklime packed in the holes and moistened, made but a humble and inefficient substitute for the use of modern machine-drills and dynamite.

As a result of these conditions, work was limited in depth for lack of pumping machinery and in thoroughness by imperfect methods of extraction. The arrastre could be erected and worked without capital other than that needful to command the services of a cheap mule or burro and, since the slowness of the process was unimportant, and little or no value was assigned to the labor of man or beast, it was effective on free-milling gold ore, even of very low grade, but useless for the extraction of gold from sulphides. One therefore usually finds that an "antigua" mine has not been exhausted in depth unless the orebody was very shallow and that, in the old workings and below them, there often is rich ore unfit for the "arrastre" but avaliable for modern metallurgy. Further, there may be waste dumps rich enough for treatment by modern methods; and at one time substantial returns were gained by a company which sent out a portable cyanide plant to treat the dumps of old "arrastre" tailing.

The Mexican native had, and still possesses, a keen instinct for the valuable ores in his native district and has probably left untouched no exposed deposit fit for treatment by his simple methods.

The ancient mine-workings or "antiguas" of Sonora are of much interest, for many of them have become richly productive in the hands of people with capital and up-to-date methods. Wherever the ancient miners worked extensively it may be inferred that they found ore profitable for treatment by their methods. That these old mines were rarely worked out is due to several reasons:

First, the lack of means for handling water, since many "antiguas" show rich ore when unwatered.

Second, the fact that the old miners knew nothing of the geology of ore deposits and did not appreciate that an orebody might be expected to pinch out or to be cut off by faults, and that a new orebody or the continuation of the first migth be found by exploration. The old Mexican miner only followed the ore and knew nothing of systematic development.

Third, the early miners only sought for ores which could be worked in the "arrastre" or reduced in their simple "adobe" furnaces. Any gold ore, not free milling, or any silver ore from which the metals could not be recovered by their simple treatment, was useless.

Copper was of little interest to them and it is not known that any mine was actively worked for copper. The Aztecs, however, used some copper tools and a small quantity of this metal was used by the Spaniards for church bells.

"Antigua" mines differ very much in appearance from mines of the present day because the following of the ore was the only purpose in view, and little if any country rock was taken out. The underground workings are therefore of very variable dimensions and extremely irregular in direction. Where the roof needed support, this was more often supplied by pillars than by timbering, and in later years "gambusinos" and others have robbed the pillars and allowed the ground to cave. The "antiguas" are therefore generally full of water or caved in.

These remarks on antigua mines and mining necessarily apply to other parts of Mexico besides Sonora.

The geology of the State has been outlined elsewhere. A summary of the subject may be given by saying that the following formations have been recognized: Crystalline terranes of gneiss and reddish granite are seen in Altar. The latter occurs also in Magdalena, and may or may not be equivalent to the granites of the southeastern districts. An extensive limestone formation, underlain by quartzite, occurs throughout the northern border of the State, apparently equevalent to that of Bisbee, Arizona, which ranges in age from Cambrian to Carboniferous. In central Alamos there is a limestone containing Paleozoic fossils, but its relation to the northern limestone is not yet known. A series of upper Triassic beds, carrying some coal, and graphite outcrops in Sahuaripa, Ures, Hermosillo, and Guaymas. Cretaceous limestone and shales are exposed in Ures and eastward, and lastly a great volcanic series of lava, tuff, plugs, dikes, and sills of quartz-porphyry, rhyolite, dacite, and andesite appears in all the districts, and contains many of the orebodies. Some of the copper deposits, however, are in limestone. Intrusive granites and diorites also occur at many points, but are not known to carry much ore.

Administratively, Sonora is divided into nine districts: Altar, Magdalena, Arizpe, Moctezuma, Ures,

* Mining & Scientific Press.

Hermosillo, Sahuaripa, Gauymas, and Alamos. These are similar in importance to our counties, but are better known to Americans as the bailiwicks of mineral agents with whom mining claims are field for record, and of stamp agents through whom mining taxes are paid to the Secretaria de Hacienda in the City of Mexico.

While the mines are legally grouped in districts, geologically and topographically, they are grouped by the mountain masses and areas that carry the veins and orebodies. In general, mineralization is more conspicuous in the mountains than in the lowlands. This is partly due to the fact that the valleys, basins, and plains are more or less covered with debris from the mountains so that, in them, rock and vein outcrops are more commonly buried, while the mountain slopes, bare of soil and vegetation, expose the outcrops so that they can be seen from afar.

This condition is, however, also due to the fact that some of the basins and valleys have not been carved out of the mountains, but lie between volcanic peaks and ranges formed by the flow of lava through vents and fissures. From this it follows, that the geology of the valley or basin is often different from that of the adjacent mountains, and it frequently bears a different type of mineralization.

From the necessary dependance of the mining industry on transportation, the mines are commonly considered in relation to the valleys, which are the thoroughfares of commerce. The chief gateways of Sonora from the north are three: Nogales by the Sonora railway, Naco by the Cananea railway, and Douglas by the Nacozari railway.

The first of these lines occupies a chain of valleys and basins from the National boundary to Guaymas, and from this central depression extend tributary valleys and plains, which give access to the adjoining country east and west. Through the valley of the Cocospera at Imuris runs a stage-line to Cananea. Through the Magdalena valley from Santa Ana run stage routes to various parts of Altar.

From Hermosillo northeastward, highways radiate through the San Miguel and Sonora River valleys, and over the plains and hills to the east and southeast are reached portions of the Moctezuma, Ures, and Hermosillo districts, as well as Sahuaripa. From Ortiz a highway leads eastward to La Dura and other points beyond, while from Empalme the new Yaqui River railway starts out to open up the mines and coalfields along this well known stream.

From Cananea, the Sonora River valley opens southward; this is an important thoroughfare, crossed by the Sonora railway at Hermosillo, with rich farming lands along the stream, and mines in the hills on either side.

From Nacozari the valley of the Moctezuma flows southward to unite with the Yaqui, while over a short divide to the southeast the valley of the Bavispe leads, by its headwaters and tributaries, to the north and east and by the main stream south to the Yaqui. It may be noted here that none of the rivers of Sonora are navigable, except the Yaqui in its lower portion.

As mining is dependent on supplies of food for man and beast it is appropriate to say a word on agriculture. This industry is at present chiefly confined to the river bottoms, and their possibilities are very great. The ranches produce large quantities of wheat, beans, and corn, the staples of consumption, beans being the chief food of the Mexican laborer. Barley and alfalfa are extensively grown for hay, and a small amount of cotton is produced. Vegetable gardening is practiced on a small scale by Chinese, but no great variety of fruit raising has been attempted, though at Magdalena and Santa Ana are produced many peaches, quinces, and pomegranates, and oranges grow luxuriantly wherever planted, notably at Hermosillo and Ures.

The unequal distribution of rainfall throughout the year necessitates irrigation in the dry season, which extends with only occasional rains from October to June. The Mexican laborer has intuitive or inherited skill for such work, excavating "acequias" or irrigating ditches, for long distances, without surveying instruments, and giving the necessary attention to the flow of water with efficient results and little apparent effort. On the river bottoms the expense is nominal, as a supply of water is near, while the irrigation of desert lands would involve questions of storage and cost, similar to those which arise in Arizona and California.

In consequence of the slight rainfall and the high evaporation, there are few permanent streams. The rains, limited mostly to the summer season, fall with great violence and cover the ground with water which does not at first form rills or brooks, but flows in sheet floods to lower levels. The accumulation of this flow gathers in "arroyos" or stream gulleys which, extending for miles as temporary conduits, ultimately discharge into some river which carries the drainage to the gulf. There are four such drainage systems in Sonora; the Magdalena, the Sonora, the Yaqui, and the Mayo.

Copper, gold, and silver are the chief metals of Sonora. Lead is of limited occurrence in association with silver and gold. Iron is known in Alamos, but the deposits are not yet developed. Antimony is mined in western Altar. Coal is of somewhat wide occurrence in the region of the Yaqui river, but is not yet mined for shipment. Graphite of good quality has been mined in Hermosillo, near Willard. Deposits of carbonate of soda and borax are also known in western Altar.

The following list of some of the better known mines of the State will give a general idea of its mining industry. Many of these have been visited by the writer and the data regarding others have been taken from sources believed to be accurate. No one, however, can enumerate the myriads of abandoned "antiguas" which, in the past, have yielded a rich harvest to the early miner, and which, in many cases, only need capital and intelligent development to make them again richly productive:

In this list the mines are discussed by districts according to the official classification.

Altar.

This district, which lies west of the Sonora railway, is the largest division of Sonora, and yieids chiefly gold and copper. Its western part is a coastal plain of low altitude with stumps of eroded mountains projecting above the general surface. It is rich in gold-bearing veins and especially in placers, most of these being local accumulations of detrital material from the decay of veinstone and impregnated rock. The district was known for the great extent and richness of these deposits long before the Spanish occupation and, in its numerous gold-bearing veins some rich mines were developed, a few being still in operation. Altar is the most arid region of Sonora, and mining is greatly hampered by the scarcity of surface water; yet that obstacle is frequently overcome by pumping from wells or rivers. In the early working of the placers, millions of dollars were taken out without the aid of water, by the "batea," or wooden gold pan, the natives being very expert in the use of this implement. The introduction of the dry washer from Hungary in 1815, has geatly facilitated the extraction of placer gold. These machines, of which various kinds have been devised, combine air-blast and agitation, the air from

ARIZONA
SONORA
CHIHUAHUA
ALTAR
MAGDALENA
ARIZPE
MOCTEZUMA
URES
HERMOSILLO
GUAYMAS
ALAMOS
SAHUARIPA
GULF OF CALIFORNIA
LOWER CALIFORNIA
Tucson
Nogales
Douglas
Naco
Bisbee
Fairbanks
Tombstone
Cerro Colorado
Old Arizac
Oro Blanco
Washington
Encina
Agua Zarca
Sta Cruz
Planchas de Plata
Saric
Cibuta
Cananea
Fronteras
Tubutama
Altar
Caborca
Calera
Sta Ana
Magdalena
Bacoachi
Inuris
Cocospera
Outyano
Arizpe
Bavispe
Bacerac
Los Picachos
Opodepe
Banamichi
Aconchi
Huasabas
Baviacora
Sinoquipe
Opuato
Muctezuma
Rayon
Carbo
Ures
Pesqueira
Zamora
Hermosillo
Villiard
Torres
Lapiz
Tarrasca
Isla Tiburon
Guaymas
Batamote
Rio Chico
La Dura
La Tayora
Soyopa
Tecoripa
Bronces
San Antonio de la Huerta
Tonichi
Trinidad
Sahuaripa
Bacanora
Mexico
Colorado
Nacori Grande
Suaqui Grande
Suaqui
Matape
Batue
Chipiona
Lampazas
Promontorio
Cedros
Trigo
Los Pobres
San Pedro
Baucari
Pitaros Verdes
Navajoa
Quintera
Alamos
Masiaca
Rio Mayo
Rio Yaqui
Rio Sonora
Rio Moctezuma
Rio Bavispe
Rio Fronteras
Rio Cocospera
Rio Cuchujaqui
Rio Matape
Rio Nacori
Rio Sahuaripa
Rio Yaqui
Rio Mayo
Rio Fuerte
Rio Sinaloa
Rio Chico
Rio Cedros
Rio Mocorito
Rio Sinaloa
Rio Fuerte

a bellows or rotary blower passing through the cloth bottom of an inclined table crossed by wooden riffles, down which the auriferous earth is made to travel by constant agitation. The blast carries away the dust and the gold is caught by the riffles. Dry methods can, of course, be pursued only in the dry season, when the dirt is free from moisture, artificial drying being as yet not in use.

This district is richly mineralized, except, possibly, in a belt about 50 miles wide along the coast from Libertad southward. Within this area few mineral deposits have yet been found. It is, however, a desert without surface water, and this important article must be carried by the traveler, both for himself and for his horses or mules. It is possible that, when more wells have been established, and mere existence becomes less of a problem for the prospector, many good orebodies may be found in this coastal plain.

Altar, the capital of the district, with a population of 1,400, is about 50 miles west from Santa Ana. Nine miles farther west is La Cuchilla, where the Rey del Oro Mining Co. had a gold property with three Huntington mills. Near La Cienega, about 60 miles southwest of Santa Ana, are extensive placers. Over thousands of acres the ground is honeycombed with shafts and drifts where the pay-dirt was reached and brought to the surface for the separation of the gold by dry panning. This region was, however, worked over again by dry washers from 1884 to 1894, 10,000 people being employed. Part of the gold of this region is in a gravel, cemented with some degree of firmness and requiring mechanical treatment by stamps or otherwise to release the precious metal. Sometimes, however, this cement gravel can be broken up by wetting and exposing to the sun and air. About seven miles northeast of La Cienega are the placers of La Yaqui, El Tiro, El Cajon, Cerro Colorado, Los Llanos, San Francisco, and La Sierrita, which have been worked intermittently for a long period.

In quartz mining also the region has been noted. The Tiro vein has been traced a long distance. At El Tiro, the north extremity, the Reina de Oro Mining Co. has sunk several shafts and is operating a 20-stamp mill. At El Cajon de Amarillas the Yerkes Gold Mining & Milling Co. has bodies of gold ore ready for stoping and a new 20-stamp mill. Cerro Colorado, between La Cienega and El Tiro has been worked for years, following rich streaks and stringers of gold ore, which was at first reduced in a small stamp-mill near La Cienega and later on by Huntington mills at the mine.

About 35 miles northwest of Magdalena is Tubutama, where the Juarez Mining Co., is developing a copper property. This company also owns the Juarez gold mine 30 miles northwest of Caborca. This is an "antigua" which was long worked as a placer by Papago Indians, who have found some large nuggets in the vicinity. In 1902 one was sold weighing 38.8 oz. The merchants of Sonora purchase placer gold from the Indians at about $26 per ounce. Its fineness usually ranges from 860 to 900.

A vein on the property was developed and worked in 1891 by a San Francisco company, which erected a 20-stamp mill with pan amalgamation. This process was not adapted to the work and a cyanide plant will be installed by the new management.

Thirty-six miles northwest of Caborca beyond the Juarez is the Palomas placer field. At La Calera, nine miles west of Caborca, the Arizona-Mexican Copper Co. of Phoenix is developing El Gran Proveedora de Cobre, a copper property on which development to the depth of 500 ft. has revealed extensive orebodies. Another copper mining company, the Ohio-Mexican, has also been operating near here with a 60-ton smelter.

On the Gulf coast near San Jorge Bay and at Quitovac, the Sierra Pinta Mining Co. has in operation two gold properties connected with the reduction works at San Jorge Bay by 13 miles of narrow-gauge railway. East of Sierra Pinta, at El Plomo and San Francisco, are important gold properties and some copper prospects are being developed. The Sombrerillo is near the Arizona line. Near Cobota also are some copper prospects of good promise. An important area of new mines is in the vicinity of the Ranch of Las Animas, near the southeastern corner of the district and about 15 miles west of the railroad. Many promising prospects are being developed here.

This region was the chief source of the great supply of gold which during the Spanish occupation poured across the Sierra Madre to the viceregal court at the City of Mexico and thence to the royal treasury of Spain. Before that time, it supplied much of the gold that the Aztecs accumulated and which was wrung from them by the "conquistadores."

In the southeast corner of Altar, on and near the ranches known as Las Animas and Las Rastras, is a group of mineral veins yielding lead, silver, gold, and copper. No large mines have yet been developed but active work is being prosecuted in a number of camps. Prominent among these are Las Animas, La Compañía, La Valedora, El Aguila de Oro, and República del Sur.

Magdalena.

East of Altar is the Magdalena district, containing a number of historic mines of the Spanish occupation. One of the most interesting of these is the Planchas de Plata, about 12 miles southwest of Nogales. The ore here is a quartz-porphyry conglomerate carrying horn silver.

About six miles north of Planchas are the Promontorio mines, owned by parties at Nogales. The ores are sulphides of lead and copper carrying gold and silver. Twenty-seven miles southeast of Nogales is the new Santa Cruz copper camp, with veins of chalcopyrite, on which have recently been denounced a large number of claims.

West of Cibuta on the Sonora railway are the Guacomea mountains, in which some mining has been done. About 12 miles east of Quijano station and 30 miles southeast of Nogales in the Pinitos mountains, is the property of the former Hays Mining, Milling & Lumber Co., now in the hands of the Columbia Consolidated Mining Co., consisting of 50,000 acres of timberland with veins of copper, gold, and silver. On the eastern slope of these mountains is the Buenaventura Mining Co. East of the Pinitos Mts., in the Cocospera valley, are the ruins of an old Mission church of that name, with vestiges of a large settlement and slag-dumps, which show that the place was once the site of large operations. On either side, in the Sierra de Pinitos or in the Sierra Azul to the east, are old mines whence came the ores reduced at the smelters. The Sierra Azul Mining Co., has developed a good orebody in one of these. At the mouth of the Cocospera river, where, by its junction with the Alisos river, it gives rise to the Magdalena, is Imuris, a small village built on a high terrace. Four miles west is the property of the Superior Bonanza Mining Co. of Calumet, Mich. This property has been partially developed and shows promising bodies of oxide and silicate ores carrying gold, silver, lead, and copper, as well as the mineral wulfenite, which is rare in this district.

Some six miles north of Imuris, on the mountain known as Cerro Blanco, is the gold mining property of the same name, long ago partially developed and recently under examination by British capital which will probably take it up for further development. From

Imuris the Sonora railway follows the Magdalena valley past the city of that name, 50 miles from Nogales. With 3,500 inhabitants, it is the capital of the district and the centre of an active trade with rapidly developing mining regions and a rich agricultural district along the river.

Thirty miles southeast of Magdalena the Dolores and Santo Domingo rivers unite to form the San Miguel. Above the junction, in the Santo Domingo canyon, is the placer goldfield bearing the name of the river, and farther up the stream is a similar deposit at La Brisca.

They were formed by the erosion of gold-bearing veins in the ranges surrounding the river valley, known as the Caliche, Sierra Azul, and Santa Rosalina mountains, forming a natural basin drained by the river. In this region are also several "antiguas," in particular the Cerro Prieto, Caliche, Rey del Oro, Klondyke, and Tucabe. The Cerro Prieto property is extensive, with a large body of lowgrade gold ore, opened by a series of adits connected by winzes through which the ore is brought down from the upper levels to the lowest, and thence transported to the mill. The latter is large, and the first unit of 120 stamps has lately been installed. The mine and mill are operated by electric power from a new plant at Magdalena. Water for the mine is pumped three miles from the Santo Domingo river. This property is operated by the Black Mountain Mining Co., of Chicago.

Seven miles northeast of Cerro Prieto is the Providencia gold property. Beyond this is the Caliche, a lowgrade gold proposition. Beyond the Santo Domingo river eastward, 12 to 15 miles from Cerro Prieto, are the Tucabe and Klondyke mines. The Tucabe operates a 15-stamp mill. Near the Klondike is the Rey del Oro, an "antigua" with extensive workings.

On the San Miguel river, at the junction of the two streams which unite to form it, is Cucurpe, the site of an older settlement of some importance during the Spanish occupation. Ten miles west of Cucurpe is La Higuera, an old camp with ruins of many "arrastres." The property is operated by the Brady-Levin Co., of Nogales. Southward along the San Miguel valley there are mineral veins in the mountains on either side and westward toward the railway are the Santa Barbara, Soledad, Otate, and other camps with many "antiguas."

About 15 miles west of Llano, on the edge of the Altar district, is the mountain country of the Rastras Ranch with many mineral veins. Near Llano station is the San Francisco mine, a gold property with a 10-stamp mill and a cyanide plant for treating the tailing, which was in operation for many years but is at present idle. Las Rieles is another property in the neighborhood. West of Llano three miles is a dry placer. The Libertd is a new gold mine operated by the Llano Gold Co. three miles northwest of Llano, while 10 miles southeast is the Caracahui range, in which are the Llano Copper Co. and the Sonora Copper Co., both actively engaged in development work. About 30 miles southeast of Llano is the Soledad mine, an "antigua."

Arizpe.

The Arizpe district adjoins Magdalena on the east and is drained by the Sonora river. About 50 miles southwest of Bisbee is the copper camp of Cananea, where the Cananea Copper Co. has developed one of the greatest copper properties in the world. Cananea supports a population of 23,000 and is the largest camp in Sonora. Besides the Cananea company a number of others have sprung up around it, there being in existence at present the Democrata Mining Co., of Cincinnati, the Indiana-Sonora, controlled by Phelps, Dodge & Co., the Cananea-Duluth, and the Cananea Central, which has recently been united with the Cananea Consolidated.

Arizpe, the capital of the district, is on the Sonora river, about 75 miles south of the national boundary, and was a place of much prominence during the Spanish rule. It is now a town of 1,400 inhabitants, though once said to have contained 35,000, and shows the ruins of dwellings, churches, and other buildings, covering a large area. Vestiges of old furnaces and slag-dumps bear witness to former metallurgical operations. This city was in 1804 the seat of government of the Intendencia de Sonora, which included the provinces of Sonora and Sinaloa. About 1823 the seat of government was transferred further down the Sonora river to Ures, once also a city of wealth and commercial prosperity. Here, in turn, the changes in commercial conditions made it advisable to transfer the State capital to a more accessible point and it is now at Hermosillo. North from Arizpe and west from Bacoachi is the Picacho gold mine. In the vicinity of Bacoachi are extensive placers, and northward, in the Ajo mountains, are several new copper prospects, notably that of the Cananea Eastern Mining Co., about 20 miles east of Cananea. Fifteen miles west of Arizpe are the Santa Rosalia gold mines of ancient fame.

Fifteen miles southeast of Arizpe, near Bavicanora, is the famous Las Chispas silver mine and near it the Carmen mine, which has recently been re-opened. Farther down the river, near Banamichi, is the Santa Elena mine, once operated by General Pesqueira. Later is passed into the hands of an English company, but it is now idle. Eight miles below Banamichi is Huepac, where a Milwaukee company is operating a small reduction plant. There are myriads of old mines and new prospects in the Arizpe district, but few companies are as yet operating there.

Moctezuma.

East of the Arizpe district is that of Moctezuma, which is bounded on the east by Chihuahua. At Nacozari is a great copper connected by a branch line with the El Paso & Southwestern Railway at Douglas, 80 miles distant. It is under the control of Phelps, Dodge & Co., who operate the Copper Queen at Bisbee, the Indiana-Sonora group at Cananea, and the mines at Globe and Morenci. The concentrate from Nacozari is shipped to the smelter at Douglas.

In the Huacal region, east of Nacozari, are many famous "antigua" mines, such as the Huacal, Doña Maria, Churunibabi, and many more. Northeast of Nacozari, 60 miles beyond the Bavispe river, is the Pilares de Teras region where are the Cinco de Mayo and Roy mines. Not far away is El Tigre, rich in gold and silver. Two or three miles farther, and nearer Pilares de Teras, are the San Juan mines. In the southern part of the district, at Lampazos, there is a silver property with a long record of rich production. The ore is treated by lixiviation. In the vicinity are many "antiguas." Copper mines of some promise are found at Transvaal and Promontorio.

Ures.

The Ures district is one of the richest in the State and the list of its mines begins at the north, in the valley of the San Miguel river where the latter leaves the Magdalena district. Eastward from the town of Tuape are the extensive copper properties of the Richfield Mining Co., upon which development work has been actively conducted. There are other old mines and prospects in this vicinity. Westward toward

the railway is the Querobabi region in which are a number of promising gold properties. Farther down the San Miguel valley, west of Opodepe and east of Poza station, is the San Ricardo, a gold mine with a record of rich production going back to ancient days. Some years ago it was operated by an American company, which erected a 20-stamp mill and shipped gold bullon. Detected in smugglin gold out of the country, the property was confiscated by the Mexican Government. The mill fell into ruin and later the claims were taken up again and sold to a Canton (Ohio) company, which has begun development and erected a mill.

Several miles west of San Ricardo is the Mina El Oro, operating a Huntington mill and shipping bullion. The Santa Gertrudis is another good property nearby. In the same vicinity is the Amarillas, a silver property with a good record. Six miles south of the Amarillas is the Socorro, which also has a good record of production. In the same region are the Nopalera, Tortuga, and others. From San Ricardo and El Oro on the north to Nopalera and Socorro on the south, an area about 6 miles by 16, the country is cut by numerous veins that show gold and silver in the croppings. A few leagues farther down the river from Opodepe is Rayon, the centre of another important mineral belt in which is the copper property of the Palo Alto Mining Co. Below Rayon is the San Francisco gold mine. Southwest from Rayon about seven miles is the Copete district, where the Copete Mining Co. has large holdings and a smelting plant of 250 tons capacity. Adjoining the Copete is the Sultana property of the Giroux Consolidated Mining Co., one of the important mines of Sonora. A shaft is down 1,050 ft. in rich oxidized ore carrying copper, lead, gold and silver. Within three years, large shipments of rich ore have been made to the smelter at El Paso. South of the Sultana is the El Colorado property of C. S. Mills and associates which is said to contain large bodies of lowgrade gold ore. North of the Sultana and Copete properties is that of the Belen Mining Co., with headquarters in Chicago. This Copete district is characterized by strong evidences of extensive mineralization and there is every reason to expect the development of some extensive orebodies. The camp is supplied with water by a pumping station at Rayon.

In the valley of the Sonora river, about 25 miles southeast of Copete and 12 miles southwest of Ures, is the Gavilan region, prominent in ancient days. Here the Ures Consolidated and the Vega Mining companies are operating, the former with a 10-stamp mill. A few miles farther up the river the Coches Mining Co. is developing a gold property.

The city of Ures, the seat of government in this district, is 56 miles from Hermosillo and has about 2,000 people. To the southeast, toward the Matape river, are the Chipiona and Colorado-Ures camps, a few miles northwest of the town of Matape. Ten or twelve miles south are the Marquesa and Quincy mines. Fifty miles southeast of Ures near the edge of the district is the Llano-Colorado region, famous for its placer diggings more than a century ago. A few miles west are the Realito mines where extensive old workings and the traces of many "arrastres" tell of active mining in former days. From the Los Angeles mine silver ores have recently been shipped.

Twenty miles northeast of Matape and about 60 miles from Minas Prietas is Suaqui de Batuc; near the confluence of the Moctezuma and Yaqui rivers. The former comes from near the Arizona line, nearly 200 miles north, and the Yaqui or Aros flows from Chihuahua on the east, turning at its junction with the Moctezuma and flowing south. Along both rivers are rich mineral regions. Southeast of Suaqui de Batuc in the Sahuaripa district, are the Santo Niño mines once owned by the Yaqui Copper Co. In the vicinity of Suaqui de Batuc are also Todos Santos, El Cajon, Zaragoza, Estrella, and other properties, several in course of development. Near Batuc, about two leagues above Suaqui, is the Lista Blanca mountain, where a network of silver veins ramifies to considerable depth and has been worked almost continuously for two centuries. There are also deposits of copper and quicksilver in the same mountain. The Tonichi copper property, owned by the Trimetallic Mining Co., is about 10 miles east of the Yaqui river, and contains a vein of copper ore with gold and silver.

Hermosillo.

South of the Ures district is that of Hermosillo, in which is the important mining camp of Minas Prietas, about 35 miles southeast of the city of Hermosillo and 12 miles from the Sonora railway at Torres, with which it is connected by a narrow-gauge line. Two large properties are operated here, the Creston-Colorada and the Grand Central, and until the development of Cananea this was the largest camp in Sonora. The region was one of "antiguas," some of the mines, including the Colorada, having been worked more than a century and a half ago by Jesuit missionaries. Depredations by Indians are said to have compelled their abandonment. About the beginning of the nineteenth century the Prietas and other properties were worked with good results by miners who had been attracted by reports of former success. After a second abandonment, on account of water, they were idle for many years. About 1860 several of the old mines, including the Creston and Prietas, were re-located by Ricardo Johnston, a man prominent in the mining history of Sonora. The two properties mentioned were pumped out and worked with profit for a number of years. The Prietas was then sold to an American company, which built a 40-stamp mill and operated successfully until operations were stopped by a fire in the shaft. In 1886 these holdings and others were taken over by the Creston-Colorada company, of Cleveland, Ohio. Subsequently the control of this corporation passed to a syndicate headed by John W. Gates. This company owns the Prietas, Fortuna, Creston, Colorada, Don Ignacio, and other properties extending a mile or more along the wider vein. The Creston, Fortuna, and Prietas are at Minas Prietas and the Colorada and Don Ignacio at La Colorada, a part of the same municipality about a mile away. Here is the mill of 30 stamps, six Huntington mills, nine amalgamating pans, and 16 Frue vanners, with a daly capacity of 200 tons. The tailing is treated by cyanide. The mill is connected by a wire-rope tramway with the hiost at the Creston shaft 1,100 ft. deep, through which is raised the ore from the Fortuna and Creston mines. About 1890 rich orebodies were developed in the Grand Central, Amarillas, and other properties on a vein parallel to that in which all former successful operations had been conducted and another great enterprise was launched. In a part of the camp known as L. Primavera, adjacent to La Colorada, are the Grand Central and Amarillas mines, owned by the Grand Central Co., and leased to the Charles Butters Co. The ore from these mines goes through the stamps and Huntington mills, and from the latter to the large cyanide plant, which employs the Butters electrolytic process of precipitation and has a daily capacity of 400 tons. The ore is said to run from $5 to $7 per ton.

Water for the mines and mills is supplied from the Matape river, 20 miles away, by a pumping plant at San Jose de Pimas. There are other properties in the Prietas

district that promise well and may, with development, become productive. Between Prietas and Hermosillo are the Dewey, Mina Grande, and several other mines. Twelve miles north of Minas Prietas is the Zubiate district, where are several silver mines with good records of production in former days. North of Zubiate and east of Hermosillo are the Tortuga, Constitution and Italia, Last Chance, Santa Rosa, and Las Cruces. About 12 miles west of Torres are the mines of the Tarrasca Mining Co. This is another "antigua" camp. Five miles east, at Aguage, are vestiges of old "arrastres" and many tiling piles, showing that much ore was treated there in the old days.

From Minas Prietas eastward, roads lead to all points along the Yaqui river, about 100 miles away. Beyond this, in the Sahuaripa and Alamos districts, lies one of the most important mineral regions of Sonora, which in old days was one of the best in New Spain. West of the river, also, in the Hermosillo and Ures districts, are extensive mining regions with historic records. Among these are the camps at San Javier, La Barranca, Los Bronces, San Antonio de la Huerta, Las Goteras, Cerro Coloardo, San Juan Grande, and Soyopa. At San Javier the Gold Coin Mining Co. has a 30-ton copper smelter. This company also owns the Santa Rosa, a well-known "antigua." At the same place the Wyman Mining Co. ,operating the Animas mine, has erected a 50-ton concentrating plant. The Verde Grande is a copper property near San Javier. At Toledo, on the west bank of the Yaqui river, the Yaqui Smelting & Refining Co., of Toledo, Ohio, has established a custom smelter, having a 100-ton lead stack and also a copper furnace. Near Suaqui Grande, on the Tecoripa river, the Chicago & Sonora Gold Placer Mining Co., a few years ago intalled a gold dredge and operated with some success. This placer field is about 30 miles long, extending along the Tecoripa river from Suaqui Grande to its junction with the Yaqui at Cumuripa. The is also a placer field along the Yaqui river, in which a dredge was operated by Milwaukee people. Northwest of Hermosillo about 40 miles are some copper properties, notably the Verde Grande, the Lluvia de Cobre, and El Mohin. The first of these has a 100-ton smelter. Near the Gulf coast in the Bacoachi region are other copper deposits now under development.

Sahuaripa.

East of Ures and Hermosillo and south of Moctezuma, the Sahuaripa district was one of the great centres of metal production in early Spanish days. It contains the Trinidad, La Bufa, Mulatos, Cieneguita, Tayopa, Ostimuris, Tejada, and many other noted mines, which, according to the Spanish records, yielded a large output of metal during nearly two centuries.

A day's ride east of Nonichi lies the region of La Bufa and Trinidad. Within 20 miles are over 100 "antiguas" that have, in early days, been large producers and promise good returns with the intelligent use of capital.

The work of the Bufa Mining, Milling & Smelting Co. illustrates the possibilities. Seven or eight years ago a few practical miners from Minas Prietas and La Dura took up the "antigua" known as La Bufa. They sunk a new shaft and at a depth of 300 ft. reached the orebodies formerly worked at higher levels, and, continuing to a depth of 600 ft., they opened a body of high-grade ore, which stood the cost of transportation 150 miles on muleback to Torres and thence by rail to El Paso. The lower grade ores were concentrated and also shipped. A 35-ton smelter was then erected and matte made on the ground.

About 10 miles distant are the Trinidad mines, once famous as silver producers. The parties who opened La Bufa have purchased the Trinidad and are pushing development work with promising results.

A day's ride northeast of Trinidad are the Mulatos gold mines. North of Trinidad are the properties of the Cieneguita Copper Co., including the Chipiona-Cieneguita, Ostimuris, and Tayopa. These are all "antiguas" with high records of production in gold and silver. Two 10-ton reverberatory furnaces are in operation. Near Trinidad are outcrops of a Triassic coalfield.

Alamos.

Adjoining Sahuaripa on the south is Alamos, noted in the history of New Spain for its production of silver. At the city of Alamos was a branch of the Public Treasury, and from it were sent out the "conductas" of hundreds of mules laden with gold and silver ingots that traversed the Sierra Madre to the City of Mexico, whence the treasure was sent to Spain. West of Alamos city is the Quintera mine, once a rich producer, and the source of great wealth for the Almada family. The property still continues in operation under a French syndicate, and is worked to a depth of 1,500 ft. An extensive iron deposit occurs about 50 miles northwest of Alamos, near the village of Cedros. At Baucari and Trigo are gold quartz mines. At El Cerrito are placers, and at Baroyeca and Piedras Verdes are deposits of copper ore.

In the extreme north of the district is La Dura, about 80 miles from Ortiz on the Sonora railway. Here are extensive deposits of copper and silver. At Batamote, 15 miles south of La Dura, the Ruby Gold & Copper Co. operates a copper mine, reducing the ores in a reverberatory furnace.

Guaymas.

Southwest of Sahuaripa is the Guaymas district, through which passes the road from Ortiz to La Dura. There is considerable mining here and many rich deposits are known, but the Yaqui Indian trouble has retarded development. At San Marcial are extensive coal messures of Triassic age. The field extends northward into the Hermosillo district, where parts of the deposit, altered by volcanic action, have been mined for graphite. In the Bacatete Mts., southeast of Guaymas, is the Bonancita region, with veins of auriferous quartz and numerous placers. At La Barranca, six mines from Toledo, is an extensive deposit of anthracite and natural coke, controlled by the Southern Pacific Railroad Company.

General.

Although its mineral wealth was known of old, Sonora was practically shut to the miner for nearly half a century after the close of the revolution against Spain. This was due to the depredations of the Apache Indians who, after the Mexican troops retired, ravished this Southwestern country. It has indeed been truly remarked that for a long time Sonora was under the Apache government rather than that of Mexico. After the purchase by the United States in 1853 under the Gadsen treaty, of the territory south of the Gila, southern Arizona was somewhat protected by soldiers till the beginning of the Civil war when, on the withdrawal of these troops, savages overran many of the white settlements. The region remained subject to their depredations and largely closed to commerce till after the completion of the Southern Pacific railway. This greatly facilitated the transportation of troops, and the capture of Geronimo soon followed in 1884. From that time dates the opening of Sonora to the modern miner.

In Sonora this metal is so frequent in occurrence that we may expect a rapid expansion of production beyond the present large output of the great mines of Cananea and Nacozari.

The copper zone of Sonora is the southward continuation of that of Arizona, and extends over nearly the whole State. Deposits of this metal occur rather frequently in all the districts, except Guaymas.

As in Arizona, so in Sonora, the principal copper orebodies are in limestone or associated with it, and, in turn, are in close relation to masses or dikes of eruptive rock, which contains copper or has stimulated the flow of a copper-bearing medium.

While the presence of green stains of malachite and dioptase on quartz veinstone has led, in many places, to the expenditure of much time and money in the attempt to make copper mines, it seems established after many trials that no one has yet succeeded in developing a substantial copper mine on a quartz vein in Sonora. In some of the silver mines, tetrahedrite occurs in quartz and from this copper comes as a by-product with the silver, but the large copper producers are all, or near, lime-porphyry contacts.

Quartz veins in Sonora, as elsewhere, are not always productive of the precious metals. Many large quartz veins are quite barren, although deposits of commercial importance are often found in the country beside the vein. Further, many of the largest and most productive orebodies contain very little quartz. Most of the large veins carry copper, lead, gold, and silver. There are few mines of silver free from copper. Gold occurs in nearly all the copper ores, so that the copper mines are usually producers of gold. A notable exception is the Pilares mine at Nacozari. Gold also occurs to some extent free in quartz veins. These are chiefly in Altar. Iron pyrite and the copper sulphides carrying gold yield, by their decomposition, oxides, silicates, and carbonates which give up their gold to amalgamation in the "arrastre."

The zone of oxidation in Sonora is generally, except on the steep mountain slopes, quite deep, and so few of the mines have been worked far into the zone of unaltered sulphides that it is too early to undertake a general discussion of the types of Sonora ore deposits.

It may, however, be stated as a result of the writer's observations that the predominant type is the impregnated shear-zone. This is a zone of shattered rock of greater or less width where fracture or faulting has occurred in a series of parallel fissures very close together. Through this fragmental material a metallizing solution has flowed, saturating the fragments to a variable extent with lead, silver, gold, copper, or other metal, but not carrying sufficient silica to form a district veinstone. Sometimes, local deposits of quartz are formed in the shear-zone, and these, when exposed at the surface, resemble true vein outcrops but do not continue far in length or depth, although there may be important bodies of ore beneath them. As might be expected, the metallizing solution appears to have usually taken a meandering course.

The orebodies are the record of a flow that has often divided in passing the less porous rock-masses, so that 'horses' are formed both along the vein and in its width, sometimes these 'horses' are not entirely barren but carry low-grade ore. The formation of large 'horses' along the shear-zone gives the effect of shoots or chimneys of ore that unite in depth. A peculiar condition, sometimes noticed, is the offsetting of the ore through the constriction of the zone of flow and its diversion in a lateral direction, to be succeeded after a distance by a widening again and the resumption of ore along the general course. The result of this is a deplacement similar to that which might result from the faulting of a fissure-vein. In the shear-zone, however, there is no marked fissure to guide the miner in determining geometrically the position of the displaced orebody. Exploration work alone will find it.

Diesel Principles in Heavy Oil Engines.

An engine which will run on crude oil without a boiler plant, consumes much less fuel than a steam plant of the same capacity, and is nevertheless free from all troubles with spark plugs, batteries and magnetos, is bound to play an important part in mining in Mexico especially in the working of small properties. There are at present engines of many makes which will accomlish all these duties with a minimum of attention, and most of them embody the principles first brought out by Diesel many years ago. Among those not familiar with oil and gas engines, it is a common belief that the Diesel is a particular make of engine. This is not the case. The Diesel patents expired some time ago, before the inventor secured any profit from them. Many different manufacturers now make Diesel engines. It took many years to bring this extremely simple and economical engine into general use, for the reason that the high temperatures and the enormous pressures employed brought up difficult questions of strength of materials for engine cylinders, expansion and contraction troubles, etc. all questions of construction. It is only in recent years that manufacturers have been able to make cylinders for the larger sizes of the engines. The following abstract of an address relivered recently before a meeting of mechanical engineers in Los Angeles by W. H. Adams, professor of Mechanical Engineering at Throop Polytechnic Institute, gives a brief description of the Diesel engine, its advantages and method of operation:

The Diesel engine of today operates by the expansion of highly compressed air in a cylinder into which fuel is gradually introduced in a finely divided state, behind a piston, the fuel being ignited by the heat of the air due to its compression. The modern engine operates under constant pressure with increase of temperature, instead of a constant temperature as covered in the Diesel patents of 1893. It differs from the gas engine in that ignition is caused by the heat of the air instead of by an electric spark and that the fuel burns at a constant pressure with explosive pressure during constant volumes and increasing temperature.

While the thermal efficiency of the Diesel cycle is theoretically slightly lower than the gas engine (Otto) cycle for the same pressure, this is offset in practice by the compression limit of 80 to 200 lb. per sq. in. for the Otto, whereas with the Diesel the compression may be safely carried to 600 lb. The danger of preignition of the vapor by high temperatures due to high compression limits the pressure with the gas engine, whereas with the Diesel the only limit is the size of parts necessary to withstand the pressure, The Diesel has a practical efficiency of 57 per cent as compared to the 52 per cent of a blast furnace gas engine and 44 per cent for a motor car engine.

Diesel Cycle.

The Diesel cycle of admission, compression, expansion and exhaust, may be completed in either two or four strokes, the present tendency being to use four strokes up to 700 or 1000 h.p. and two for larger engines. The four cycle gives about 15 per cent better fuel economy, has a lower mean temperature, allows more time to remove burnt gases and its valve gear operates at half the speed of the main shaft. The two

cycle gives from 170 to 180 per cent more power for the same size of cylinder, consequently requiring less weight, space and first cost, and has a simpler valve gear.

Both horizontal and vertical types are manufactured, 1 to 4 cylinders being used in the former and 1 to 6 in the latter. The horsepower per cylinder varies from 30 to 250 with cylinders of from 12 to 21 inches. Engine sizes vary from 110 to 2500 h. p. Speeds range from 150 to 550 r. p. m. with piston speeds of from 600 to 900 ft. per min. Single-acting engines without piston cross-heads are the rule.

The two cycle engine requires only a fuel valve and air-starting valve as the piston acts as its own valve, although the better class of slow speed engines have seven valves in the cylinder head, four scavenging, one fuel, one starting air, and one safety. The four cycle must have at least four valves, suction, exhaust, fuel and starting. As the engine is governer by the amount of oil introduced in about 1-40 of a second, the fuel valve is most delicate.

A compressor supplies air at 800 to 1100 lb. pressure for spraying the oil into the cylinder, from 16 to 34 cu. ft. of free air being required per brake horsepower per hour. This requires from 4 to 7 per cent of the power developed by the engine. The compressor may be driven by an independent motor or from the crank shaft direct. The two cycle engine also requires air for scavenging, this not being necessary in the four cycle. The scavenger pump requires about 4 per cent of the engine output.

A regulation of a least 3 per cent is secured by varying the amount of fuel fed to the engine by means of some form of governing device. The Diesel has an overload capacity of only 10 to 15 per cent.

From 3 to 9 gal. of water per b. h. p. per hour are required to cool the cylinders and cylinder heads. This carries away from 2500 to 3000 B.t.u. per b.h.p. per hour.

In the Diessel engine 34 per cent of the heat in the fuel accomplishes useful work as compared to 25 per cent utilized by a turbine plant.

The efficiency depends upon the grade of fuel, ranging from 0.4 lb. to 0.5 lb. oil per b.h.p.-hr. The economy and thermal efficiency remain nearly constant at from 60 per cent to 120 per cent of the rated load. The mechanical efficiency tends to increase as the load increases, being about 75 per cent at full load for a four cycle engine and 70 per cent for a two cycle.

The weight per b.h.p. varies from 250 to 500 lb., the higher priced engines being heavier. The cost varies from $48 to $80 per h.p., according to the size, the large engines being comparatively cheaper.

Fuel and Lubrication.

Crude oil which is free from sand and water can be used as fuel even if it contains as much as 50 per cent asphaltum. Eastern oils have given better satisfaction than Western, on account of the viscosity and high sulphur, water and ash content of the latter. The viscosity can be remedied by heating with exhaust gases or cooling water. The sulphur constant should not be more than 2 per cent to 4 per cent, as it forms sulphurous acid gas which corrodes the engine parts. The water content should be less than 2 per cent as it decreases the heating value and makes the engine run irregularly. The ash remains in the cylinder, cutting its walls the valves and valve seats. It can sometimes be removed by heating the oil and straining while hot. By using kerosene for starting and before shutting down all the heavy oil may be removed from the pumps and piping. Several engines are operating satisfactory with California oil of from 14 to 18 degrees gravity.

About 0.01 pint of lubricating oil is required per b.h.p.-hr. One engineer can handle 1000 to 1500 h.p. per shift, keeping the engine supplied with fuel and lubricating oil and cleaning the fuel valve and exhaust valve not oftener than once a week.

The maintenance charges seem to average about one per cent of the first cost of the engine per year. The Busch-Sulzer Diesel Engine Company have two 225 b.h.p. engines in Texas which have been operating 18 hours a day for over nine years. The cylinders have never been rebored and now show very little wear, being as smooth and bright as glass.

It seems to have been fairly well established that the Diesel engine can operate continuosly for at least 6½ days out of the seven for an indefinite period if short intervals are allowed for minor repairs and overhauling. The engine can not carry more than its rated load for any length of time, exhaust valves being especially liable to burning. Particular attention should be paid to the air compression and to avoiding water or dirt in the oil. As the engine has a poor starting torque it should be run at nearly constant speed.

The Diesel engine is well-adapted to freight vessels and gives excellent service as a pumping engine. It can be used for electric service if several units are installed so that each will work near its rated load. Its general adoption has been delayed in the past by certain mechanical defects which have since been corrected and by the availability of cheap fuel which has prevented the use of a prime mover with high first

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Wear of Stamp Dies.

W. G. Urquhart, in the Journal of the Chemical, Metallurgical & Mining Society of South Africa, expresses the opinion that the uneven or irregular wear of dies in stamp batteries may be prevented by the judicious use of the "diagonal die water service," delivering the water directly upon the die. The wear of the die, he states, is in accordance with the order of drop in use, providing that the weight and height of drop are the same. Thus with an order of drop of 1, 3, 5, 2, 4, dies Nos. 1 and 2 wear least and hollow most, Nos 4 and 5 wear most and hollow least because Nos. 1 and 2 always have more ore upon them than Nos. 4 and 5. With the order of drop 1, 5, 2, 4, 3, Nos. 4 and 3 wear least and hollow most; Nos 1 and 5 wear most and hollow least for the same reason.

With the same order of drop when the diagonal water supply is used, all jets being the same, the results as far as wear is concerned are practically the same, but the dies are less inclined to hollow because the water playing upon them washes off the crushed particles and leaves clean ore upon clean dies for the next blow.

In the opinion of the author the cause of caving is the fact that after the stamp has struck its blow, the crushed particles on the dies are gradually ground in, new particles being added with each blow of the stamp. The remedy is the use of sufficient water distributed in proportion to the requirement necessary to clean each individual die. When the ore banks most the larger quantity of water is used. By using too much water a slightly rounding effect is produced on the die, exactly the reserve of the case when the water is used too sparingly. If it is desired to take the "cave out of a die, it is advisable to feed fine and use plenty of water.

Copete Ore Deposits of Sonora.

Among the mines of Sonora are the Copete properties named from a copete, as it is called in Mexico, which forms the apex of a mountain of some prominence. Roughly measured the copete appears to be from 100 to 150 ft. long, and some 300 ft. across at its greatest width. It is one solid mass of ore, a heavy, iron-black material, carrying some copper and a little gold. The material is of low grade, otherwise it would be a mine of wealth, without considering any of the other ore exposures on the copete property.

Such a remarkable development of ore has caused many people to think that at the copete a great ore shoot, a body of gigantic proportions goes down into the earth, and that an inexhaustible mine will there be developed.

A recent examination of this property leads me to disagree somewhat with reports which have been made by others who examined the property at various times, and I am inclined to the opinion that the copete or cap of ore, is in common with other cappings in adjacent hills, a remnant of a great blanket vein, which at one time covered the country. I see indications of very great ore developments, but I do not consider that the cappings of ore which are found at several places on and near the copete mines are outcroppings of ore shoots or veins, but are remnants from a blanket vein, the greater part of which has been eroded away. The lower western portion of this once gigantic vein aparently dips down into the earth on the western part of the Copete property; its course and outline being in many ways conformable to the position and dip of the remnants of precisely similar ore capping the mountains to the east, and it is not unreasonable to believe that its extent is equal to the indications of size as shown by these remnants of the vein found capping the hills immediately to the east.

This is a rough outline of the Copete porperty. Northwest and some distance from it are the mines of Cananea, where we were told that mountains of ore existed. Reports of later experience indicate that these ore bodies, which were reported to be of enormous size and unknown depth, are being cut through into barren ground, and explorations are constantly being undertaken to uncover new ore bodies. Fortunately success, it is stated, follows the work, and no lack of ore is reported at the Cananea properties. These statements are gathered from miners who, on returning home after working for a time at Cananea, tell of how this or that shaft ran out of ore, and how a new shaft picked it up again.

Great reliance cannot be placed on miners' gossip, yet by listening to them one may pick up shreds of information, and it seems to be indicated by their statements that an enormous blanket vein, not mountains of ore, but an enormous blanket vein covering and outcropping on mountains is the formation at Cananea.

Many people have remarked the similarity of appearances at Copete with those of Cananea. This may be considered a reasonable comparison, excepting that at Cananea we may consider that the ore bodies have not been seriously eroded, while at Copete erosion has been excessive. So extensive has this action been that for a greater part the upper porttion of the ore has been eroded away, leaving remnants of mineral capping the hills and mountains of the Copete district. all of which are east of a long exposure of similar ore, apparently outcropping at the ridge referred to, and extending north and southerly along the western portion of the Copete mines.

The ore exposed for a considerable distance along this ridge is in every respect similar to the ore capping the hills to the eastward, and in its general dip and location seems to conform exactly to the outlines of these remainders of ore; a condition which leads me to believe that at this point the blanket vein dips down, and gives promise of developing a mine of most unusual proportions. The one condition which is against this assumption is the position of this apparent ore exposure, which is directly on the apex of the ridge where it might have been left under the same action of erosion by which the remnants to the eastward were formed.

Still as no similar ore is found west of this ridge, and as apparently conformable ore remainders of gigantic proportions are found regularly and conformably to the eastward of the ridge, the burden of evidence favors the assumption that at this point a great blanket vein dips down into the earth; its vast proportions being indicated by the eroded remainders of the same vein capping the mountains immediately to the eastward. This supposition is further emphasized by the fact that the remainders capping the mountains to the eastward have been prospected, and have been cut through, proving their superficial nature, while at the ridge prospect shafts have been cut to some depth, the ore continuing without interruption. The quality is, however, a low grade in a gigantic exposure capping an ore deposit which gives promise of very great developments of low-grade ore as the reward for its exploration.

It is the writer's opinion that the ore which will be uncovered will be a formation similar to those enormous lowgrade propositions which modern engineering has made profitable.

Geology.

From a single examination of a district it is somewhat difficult to draw a geological outline of its formation, and the development of rocks at Copete are certainly the most complex. Volcanic and intrusive rocks predominate, with numerous developments of residual formation originating in the alteration and weathering out of the eruptives. As a broad description of the geological features of this region, attention can be called to an extensive formation of hard siliceous rocks, commonly called quartzites, and extending northwest and southeast as a broad irregular geological belt through central Sonora. By all accounts, and by personal observation so far as my explorations went, this siliceous belt of rocks is not mineralized. On the eastern edge of this zone are some of the great mines of central Sonora, but located beyond the region of our inquiry.

West of this siliceous belt or zone, at the mines under discussion, is a region of recent eruptives. Between this zone of eruptives and the siliceous rocks is an irregular development of rocks, which appear to be older than the eruptives, and more recent than the siliceous rocks. Alteration has occurred among them, and apparently they have been crushed against the siliceous zone, an action which may have caused a development of longitudinal shearing and shattering, during the formation of which the middle rocks were sheared over the siliceous rocks; these latter being of greater extent and hardness, would probably have

* Abstract of an article by F. C. Nicholas, in Mining World.

Old Mission Bells, San Fernando, Lower California.

Plaza at Havana, Cuba.

Village Street in Mexico.

Hotel at Altata, Sinaloa.

Taxco, Guerrero.

Atlistac Mill, Guerrero.

resisted, while the soft rocks of more recent formation lying against and above them would be crushed and sheared forward under the influence which finally culminated in the outbursting of the great zone of eruptives a little to the west.

In the zone of rocks crushed against and sheared over the siliceous rocks, mineralizing influences developed in force, resulting in the formation of numerous ore bodies, one of which, the Copete mines, occupies what appears to be the region of contact, and it places part of the contact itself between the siliceous and the more recent zone of rocks. The influence which has caused the earth movements and activities, out of which the ore bodies of the Copete mines were developed, must have been of such magnitude that strength of mineralization would probably have occurred, and the great size of the ore exposures as found today give indications that developments of importance may be anticipated; yet because of the great size of the ore bodies rather low-grade material would be most probable. The exposures of ore are heavy black iron oxides carrying copper and a little gold. At a considerable depth, some 500 ft., iron sulphides are abundant with copper, sulphides in varying amounts and low gold values. The expectations are entertained that with greater depth copper will increase. This would seem a reasonable assumption, because such increased developments of mineralization occur at many copper mines.

One condition, however, is to be contended as somewhat adverse, where all else seems easy and certain almost to develop great values for the Copete owners; this is the fact that the country is faulted, and that as yet the Copete ore deposits have not been successfully explored for depth. The fact, however, that the ore bodies are so enormous in their exposure indicates that great depth and permanency will be proven by a reasonable amount of exploration.

To explain why permanency may be expected: The ore exposures of the Copete country can be described as a series of remnants capping hills, these hills and ridges being composed generally of hard siliceous rocks resembling quartizite, and which at many places present all the characteristics of a true quartizite. At other places the rocks appear to be siliceous eruptives. Taking a prospect line which would cross the Copete from east to west over a course of about 5 miles, we have first a series of iron oxide developments, capping the hills of a property known as the Iron Duke. These exposures have been cut through, showing their superficial character.

Proceeding westward, these ore remnants grow stronger and more pronounced, until the Copete is reached, where the ore exposure is so great that it forms a feature of the landscape visible for long distances. Proceeding still father westward, an exposure of ore of precisely the same character is found extending generally north and south, near the summit of a ridge of considerable height, and probably something over a mile long. To all outward appearances the ore exposure on this ridge is exactly similar to, and conformable with, the ore on the Copete, and with the capping of ore on another hill about ½ mile south of the Copete. The appearance of the ore on the ridge corresponds with the ore capping of both the Copete and the San Miguel, which can be seen to the eastward, hence by reasonable inference, it may be anticipated that this long exposure of ore marks the place where the formation goes down into the earth. Especially does this seem reasonable because of the fact that proceeding westward in any direction, exposures of ore similar in character are not found.

In discussing depth of mineralization many have claimed that under the Copete itself is a great ore shoot which will be found, and because of the enormous mass of this exposure such developments are quite possible, particularly if, at the Copete, there were in former ages vents or chimneys in the rocks, up which volumes of mineralizing solutions could have made their way to spread out and form a great blanket vein, between the hard siliceous rocks and overlaying rocks, which have since been eroded away. The preponderance of evidence seems to be, however, that the mineralizing solutions came up along the zone of the overlying rocks which had been crushed against and sheared over the harder siliceous formation and that the great ore exposure on the ridge west of the enormous remnants left by erosion indicates the region where, with perhaps a fault or two intercepting, this great ore deposit goes down to depth.

Old Mining Camp of Pozos, Guanajuato.

In the present state of metal mining in Mexico, with so many of the large properties in the hands of foreign interests and strangers searching in every corner of the republic for mines, new or old, which may be worked profitably, it is rather rare to find a well worked district which has never received that careful examination which is generally accorded the more important camps by those in search of real mines. According to the best obtainable data, the camp, of Pozos, Guanajuato, has never even been visited by many foreigners, and none of these have inquired into it thoroughly. This seem strange in view of the fame the district has enjoyed from time to time due to the production of bonanzas, several of the large mines having enjoyed periods of production of rich ore which attracted the attention of the whole republic.

The mineral district of Pozos is situated in the eastern part of the State of Guanajuato, 10 km. south of the town of San Luis de la Paz. The latter is the "cabecera," or capital of the district of Cerro Gordo, which includes the district of Pozos and several other less known camps. Pozos is about 120 km. northeast of the city of Guanajuato at an elevation of about 7500 ft. above sea level. The climate is temperate, but the winter season generally brings rather cold weather, due to the north winds to which the camp is exposed, the temperature often falling below the freezing point.

Generally speaking, the district is dry, rains being rare and even the rainy season failing to bring the heavy showers usual in the plateau of Mexico. Communication is established by means of a branch of the Ferrocarril Nacional, which connects Pozos and San Luis de la Paz with Rincon, a station on the main line just north of the city of Doolres Hidalgo.

History of the Camp.

The mines of Pozos have been known since the early part of the eighteenth century, the tradition being that several of the mines, notably the Santa Brigida and Ocampo, were worked by the Jesuits, their possession being terminated by the expulsion of their order from the country in 1767. After this time, the mines were worked in a desultory fashion, until 1844, when they were completely abandoned. In 1871 work was again undertaken, the first step being the denouncement and active development of Santa Brigida, which in 1873 passed into the hands of the Parkman family.

The Parkmans, a family established by the settlement of an American in the city of Guanajuato, became a powerful factor in local mining circles and acquired large interests, not only in Pozos, but in the district contiguous to the city of Guanajuato, where they were best known as the owners and operators of the Sirena mine and the Hacienda San Francisco de

Pastita, both of which are now owned by the Guanajuato Consolidated Mining and Milling Company, an American corporation with its home office in New York. The Parkman family has long since ceased to be of importance in commercial circles, although they still hold a large part of the Santa Brigida mine.

The fame of Pozos as a producer, began to grow in about 1880, and by 1888 many companies had been formed and were progressing successfully. Among these were the Cinco Señores company, which included the mines of La Joya, Nayalito and Justicia. Up to 1895, this company had divided among its stockholders more than $3,000,000. To the same epoch belong the mines of Angustias and Argentina, which are credited with dividends amounting to over 2,500,000 pesos. Many other mines have been more or less worked and have paid various sums to their owners.

Patio Process Employed Until Recently.

The main dependence of the Pozos mines has always been the high-grade ore, which was shipped to San Luis Potosi and Aguascalientes, involving large expense before the railroad was completed in 1902. Due to high freight and treatment charges, the operators were forced to contemplate treatment of the ores on their own account and the result was that several "haciendas de beneficio" were established, two in Pozos and several in San Luis de la Paz.

One reason for the selection of the latter town for the establishment of the reduction plants was that water and labor were available, while in Pozos the only water obtainable was that from the lower levels of the mines. This water, being acid and heavily charged with iron salts in solution, was not well suited for reduction work, and, in fact, it is found at this time to be quite unsuitable for use in cyanidation. Possibly the main reason, however, might be found in the fact that San Luis was a well established town, large in comparison with Pozos, and offered commercial and social advantages which made the living there much more comfortable than in the mine town where conditions were naturally more crude.

The earliest plant to be established in San Luis de la Paz was the Cinco Señores, after which the Ojo de Agua, San Jose and Santa Elena followed, the latter being the property of the Angustias company. Ore and fuel was delivered to the plants by burros until the establishment of the Ferrocarril del Bozo, a minature railroad, which connects the mines of Pozos and the "haciendas" of San Luis de la Paz with the "hacienda" del Bozo a ranch in the nearby mountains. A lower transportation charge was thus assured on ores, with advantages in the ecomical supply of fuel.

All of these plants were designed to treat ores by the patio process, some operated entirely by animal power, and others grinding and concentrating by steam power and utilizing the mules only for the amalgamation process.

Cyanidation Coming Into Use.

Following the history of all the Mexican camps, the ores at length became too low in grade to permit working by such expensive processes, interest in the camp began to lag, development fell off, and practically all work ceased. In a paper presented to the Sociedad Geológica Mexicana in the early part of 1901, Manuel Balazero, a mining engineer of the country, said of Pozos:

"This camp had its period of mining delirium from 1890 to 1896 during which period the mines of Cinco Señores, Angustias and Argentina reached their greatest production. Claims were denounced on every hand, reaching parts where the veins were notable only for their absence, following mythical 'continuations or extensions.' Their owners, guided only by the fever of speculation which possessed them, organized more than 50 companies, of which more than 30 were performing actual work. It is needless to say that these companies vanished as soon as the interest stimulated by the bonanza production of the larger mines had ceased, accomplishing the ruin and discredit of the entire district."

In 1909 the Cinco Señoñres company, desiring to profit by the large tonnage of low-grade ores existing in its workings, established a plant in Pozos for treating these ores by cyanidation, this being the first systematic attempt to apply modern methods to the ores of the camp. This plant is now at work and shows every indication of successful operation.

The Angustias company joined forces about two years ago with the owners of the Dolores mine adjoining, thus making a strong company owning valuable mines and the Santa Elena reduction plant at San Luis de la Paz. The mill had been formerly rearranged in a fashion for cyanide treatment but without any brilliant results and the company redesigned and rebuilt it in the latter part of 1909. It is now successfully and profitably treating the lower grade ores from the mines.

The "hacienda" Ojo de Agua has also been remodeled for use as a cyanide plant, and is about ready to begin work. This mill treats custom ores daily from the Pozos camp, having contracts with many of the smaller mines for the ore supply. The Garibaldi mine is equipped with a simple cyanide plant, which, as the ore consists largely of chlorides and bromides of silver, gives good results.

The Santa Brigida company has equipped its property with furnaces for reducing the ores, but these are not at present in operation, the high-grade ore only being mined and shipped.

Occurrence of the Ores.

The district of Pozos lies in a small valley between the higher hills. This valley measures about 8 km. north to south, and about the same east to west. The veins are fissures in the argillaceous slates, with strike northwest and southeast, and dip toward the southwest. The bedding planes of the slates of the western part of the valley are inclined toward the northwest, and in the eastern part toward the northeast. These bedding planes are often filled and in some places replaced with lime deposits, and occasionally these deposits are so marked as to seem veins although they carry no gold or silver. The veins are usually filled with quartz, which carries the valuable metal deposits.

A bed of clay covers the slates for practically the entire extent of the valley. Over the clay there is a bed of talus, consisting of fragments of porphyry and basalt in some places and in others largely mixed with broken vein matter from the old crests of the veins. This bed is in some places impregnated with the clay and has been so cemented by lime impregnations as to form a sort of conglomerate. Above the talus appears a bed of limestone, thick in the valleys and thinning out near the summits of the hills. The present soil is thick in the valley but does not exist on the higher points.

The veins outcrop, the limestone covering them in most beds, but erosion has exposed them in the cañons where the limestone beds have been sufficiently worn away. The veins of the camps can be divided into two classes, according to the nature of their contained mineral.

In the Western group the ores near the surface

consist principally of chlorides and bromides of silver with comparatively large proportion of gold. At depth these veins change their chacteristics, the ores being antimony-bearing silver sulphides. The principal examples of this group are the veins of La Joya, Escondida, Trinidad, Dolores, Angustias, San Rafael, Mina Grande, etc.

The Eastern group, including the mines of Santa Brigida, La Reforma, etc., is distinguished by the presence of oxides and carbonates of lead copper near the surface, and at depth galena, chalcopyrite, native and gray copper with some blende.

The veins are of various widths, the narrowest being a little more than one meter wide, and the stronger veins reaching a total with of 20 m. in some places. The camp contains 17 shafts more than 100 m. deep, the deepest at present being 240 m., or about 780 ft. The veins are found in good condition and in good ore at the greatest depth, which speaks volumes for the permanency of the camp. The topography is generally not favorable for tunnel development, but there is one tunnel, that of Dios Nos Guie, which has a total length of 1060 m., or about 3450 feet.

At present the camp of Pozos seems to be experiencing a sort of mild revival, interest being taken in the work and the reopening of several old properties being considered. That the district is worthy of careful attention seems to be undoubted.

*Gold Region of the Strait of Magallan.**

The Strait of Magellan intersects the southern end of South America from east to west. To the North is Patagonia, and to the south is the archipielago of Tierra del Fuego. Both these regions are owned partly by Chile and partly by the Argentine Republic. The Chilean possessions in the Magellan region, on both sides of the strait, are official known as the Territory of Magallanes, a term locally abbreviated to 'Magallanes.' Patagonia represents the southern end of the mainland of South American, terminating at Cape Froward, in the Strait of Magellan. The name of Tierra del Fuego properly belongs to the whole archipielago of islands lying south of the Strait of Magellan and north of Cape Horn. It comprises an area extending about 500 miles from northwest to southeast and about 200 miles wide. The two main tidewater channels are the Strait of Magellan on the north and Beagle Channel near the southern part, intersecting the region from east to west. There are numerous other minor and transverse channels, dividing the archipielago into many islands. South of the Strait of Magellan, in Tierra del Fuego, the western and southern parts of the archipelago are rugged and mountainous, some of the peaks rising fron 3000 to 7000 ft. above the sea. This region represents the southern extension of the Andes, which here turn to a southeast course, and then to an east-and-west course, finally terminating in the rugged Staten island, the most easterly member of the archipelago. The northeastern part of the main island, however, is a more or less flat or rolling country, and partakes of the nature of the pampas of eastern Patagonia. Tierra del Fuego probably owes its condition as a group of islands to a partial submergence of the southern end of South America. The islands appear to be the upper parts of old mountain peaks, and the numerous straits, channels, and bays mark the courses of the old canyons and valleys. The rocks of southern Patagonia and Tierra del Fuego have not been much studied, but it may be said that they are mainly granites, various igneous rocks, and slates; while in the low pampas country in eastern Patagonia and the northeast part of the main island of Tierra del Fuego soft, sandy, and argillaceous strata predominante, probably Mesozoic and Cenozoic.

Gold is said to have been discoverd in southern Patagonia by the Chileans over 40 years ago and is supposed to have been known to the native Indians at a much earlier date, but has been produced in quantities sufficient to attract general attention only in the last twenty years. The gold in the gravel of Rio de las Minas, near Punta Arenas, was one of the earliest discoveries. Another was the gold in the beach sands near Cape Virgins, at the eastern entrance of the Strait of Magellan, discovered about 1876, but not actively worked until 1884. An Austrian named Julius Popper was among the most active operators at that time, especially on the east coast of the main island of Tierra del Fuego. Gold was actively worked on both sides of the Strait of Magellan, but the principal localities were the gravels in the Rio de las Minas near Punta Arenas, the beaches at Cape Virgins, and from there southwestward along the shore to Point Dungeness; the gravels on several small streams to the eastward of Porvenir, across the strait from Punnta Arenas; the beach at Paramo northeast of San Sebastian bay, on the east coast of the main island of Tierra del Fuego; Navarin island, Lennox island, New island, and Slogget bay in the extreme southern part of the archipelago near Cape Horn; New Year island, which lies north of Staten island, at the eastern end of the archipelago; and several localities in the western islands of the archipelago. In fact, gold has been found generally distributed through the Magellan region.

About the year 1904 preparations to use steam dredges started the boom afresh. From all over Chile and Argentine again came the gold-seekers, with some from a still greater distance, and the usually almost deserted Strait of Magellan became animated with small craft. Since that time work on the gold deposits has steadily progressed, in a much more systematic manner than formerly. In 1907 some twelve dredges were in operation or being constructed, and the gold industry of the region promises soon to become important. The most active man in introducing dredges has been an American, John D. Roberts. The dredges are not used in handling the beach deposits, as the fury of the storms would soon batter them to pieces; their use has so far been confined to the inland deposits.

Until recently the largest gold-mining operations were at Paramo and Lennox island, but since the introduction of the dredges, the most active operations are on the northwestern part of the main island of Tierra del Fuego, across the strait from Punta Arenas. Here the town of Porvenir is the headquarters of the industry. This town in now a prosperous mining centre of about 800 people. In addition to the Porvenir region, mining on a small scale, but of more or less importance, is still going on at some of the other localities.

The chief centre of civilization in the whole region is the Chilean town of Punta Arenas, a name which in English means Sandy Point. The town is on the Patagonia side of the Strait of Magellan and has a fairly good harbor. It is the seat of government in this part of the Chilean possessions and is an active place of 12,000 population. The settlement of Ushuwaia, which is the seat of government of the Argentine part of Tierra del Fuego, is only a small place. Punta Arenas is in 35° 9′ 42″ south latitude, and has the distinction of being the most southerly town of any considerable size in the southern hemisphere.

* Abstract from paper in "Journal of Geology."

Punta Arenas was started by the Chilean Government as a penal colony in 1843. The Chilean Government finally ceased using it as a penal colony and encouraged its settlement by free Chileans. For a long time it was the headquarters for sealing and whaling vessels, until the seal sand whales became nearly exterminated. In recent years Punta Arenas has prospered, first by the development of the sheep industry in Patagonia and later by the advent of the gold miner.

The gold of the Magellan region is, so far as at present known, most all in alluvial deposits. Very few gold-bearing veins have been found. The alluvial deposits may be divided into two classes, those in beds of creeks or on hillsides, and those on sea beaches where they are subject to the action of the sea during the falling tides and during storms. The alluvial deposits in beds of streams or on hillsides vary in gold content from a few cents to $1 or more per cubic yard, but most of the ground that is now worked is said to range from 25 to 50c. per yard. Under the conditions existing in the region, it is difficult to make low-grade ground pay, but some of the operators expect, with steam dredges, to make a profit on low-grade ground. The gold-bearing beds vary from a few feet to 10 to 30 ft. An overburden of barren ground often occurs.

The gold on the beaches is sometimes on the immediate surface and sometimes covered by from a few inches to several feet of barren sand. On some beaches it is well up on the shore, on others it is near the water-level, and on still others it is below the water-level. The sandy strata carrying the gold are rarely over a few inches thick, but often rich. The gold is associated with large quantities of black sand, which seems to be mostly magnetite; there are also numerous small garnets. The gold, whether from the creeks, hillsides, or beaches, is said to be quite pure, though it often contains a little copper and silver. It occurs generally in rather fine particles but sometimes small nuggets, often flat and about the size of lima beans, occur, and occasionally still larger ones are found, but no great nuggets have yet been discovered. The gold in the beaches probably came largely from the later erosion of the alluvium in the creek beds and on the hillsides, and perhaps partly from old submerged alluvium, from which the gold was thrown up by the sea. It is said that the beaches, after having been carefully worked for gold, seem again to become rich in that metal after a storm or an unusually high tide. A similar phenomenon is observable in the gold-bearing beach sands of Cape Nome, Alaska. The ordinary tides in the eastern part of the Strait of Magellan have a rise and fall of 30 ft., and the spring tide, 45 to 50 ft., though in the western part of the strait the tides have a much less rise and fall. The great rise and fall of the tides on the Atlantic side cause rapid currents in the strait, often with a velocity of 7 or 8 knots per hour, and these, scouring the beaches backward and forward, must have a marked effect in concentrating the gold. In fact, the conditions in the Strait of Magellan represent a natural process of concentration, not at all unlike some of the artificial processes that man has found best suited for concentrating gold.

Prospecting in the Strait of Magellan and Tierra del Fuego is a more difficult task than in most places, and many a man has lost his life in his search for gold in that bleak, inhospitable region. Traveling is mostly done in boats, as the land is much cut up by deep tidewater channels and bays, and covered with dense underbrush or immense peat bogs; while everywhere, even on the mountain sides, the soil is soft and boggy, so that walking is difficult and often impossible. The climate, however, though stormy, is not extreme, the thermometer rarely going much below zero or much above 60° Fahrenheit. The mean winter temperature is about 33° F. and the mean summer temperature about 50° F. The season during which mining can profitably be carried on is from August to May. During the rest of the year frost and snow hinder operations. The capital at present invested in the industry is mostly Chilean and Argentine.

Palmilla Mine, Parral, Chih.

The lower levels of the Huanachaca de Bolivia mine, at Pulacayo, Bolivia, which were flooded a few years ago, are being unwatered, 6000 metric tons being handled daily. The workings in this mine are extensive.

There are miles of underground workings, and the depth below the outcrop is 750 meters or 536 meters below the main level. The water from the lower levels has a temperature of 56 deg. C. Ventilation is an important feature, the mine making large quantities of carbonic acid gas. The equipment includes several 100 h. p. ventilators, large pumps, boilers, a 75- mile transmision line for electric power, a machine shop that would compare favorably anywhere, electric locomotives for underground work, and a 30- kilometer railway connecting with the main lines of the country. Most of the machinery is of French and English make with occasional units of American manufacture. The company is organized largely with French capital, headquarters being in Paris. W. Lorrain Cook, formerly of Pachuca, is mine superintendent.

Scheelite is the tungstate of calcium with 80.6 per cent tungstic trioxide. It is a heavy, non-metallic, white, (sometimes yellowish, brownish, grayish or greenish), mineral occuring in masses, square pyramids, and drusy crusts. When finely powdered and heated with strong hydrocholric acid, it partially dissolves leaving a vellow residue. If tin or zinc be then added and the heating continued, the solution will turn blue.

In addition to exhibitions of Mining and Metallurgy at the Panama Pacific International Exposition a special exhibit has been prepared showing the equipment and methods of geological surveys. From the description given in the circular recently issued it appears that the geologist will be well repaid for a visit to the exhibition of matters of a geological character which may there be observed.

The Tunky Mining company, of Philadelphia, is reported to have purchased the Potosi mine at Siuna, Nicaragua. Plans are under way to begin active operations at once. Roads are to be built and the enterprise is expected to stimulate activity in the whole Prinzapolka valley. Other mining properties in the district are La Luz and that of the Los Angeles Mining Co.

Metallurgical Smoke.

With the idea of bringing about a better understanding between the metallurgical industry and agriculture as to the troublesome smoke problem at smelting and ore-roasting plants, the United States Bureau of Mines has just issued Bulletin 84, "Metallurgical Smoke," by Charles H. Fulton, consulting metallurgist.

The bulletin is published primarily for persons who seek information on the subject of metallurgical smoke but are unacquainted with the technical language of metallurgy. It is, or course, not possible to free a technical subject entirely from technicalities, but, so far as possible, statements are made in plain and simple English.

Metallurgical smoke causes considerable friction between the metallurgical industry and agriculture in certain parts of the country. Owners of smelting plants are making every effort to devise ways and means to do away with possible damage and annoyance from smoke and are meeting with success.

The problem is peculiarly difficult because of the large tonnages of material that must be handled. The solution of the problem is not yet at hand and much work still remains to be done. As the mineral industry is one of the great basic industries of the country and of necessity is entitled to full consideration, it should be accorded freedom to work out the smoke problem to the benefit of all concerned. The effort is made in this paper to present the problem of metallurgical smoke as it actually exists, without bias of any kind.

The author says, "Sometimes, in discussions of the smelter-smoke question by interested parties, gross misstatements of fact are made. Thus, the agriculturist sees bad effects from smelter smoke which other people cannot find, and the metallurgist sometimes goes so far as to claim that smelter smoke is beneficial to vegetation, and even to assume that the damaging constituent of smelter smoke is sulphur trioxide only, giving rise to sulphuric acid, and to ignore entirely the sulphur dioxide content. It is evident that nothing is to be gained by a policy of this kind, and the solution of the problem lies in its study by disinterested commissions, such as the one recently appointed by an agreement between the Department of Justice and the attorneys of the Anaconda company to study the smoke question in Montana in its relation to the forest reserves.

It is interesting to review the general situation in this country. Much of the trouble is in the Western States, and chiefly in Montana, Utah and California. In those States very large tonnages of sulphide ores are smelted with the production of great volumes of smelter smoke, comparatively rich in sulphur dioxide and other injurious constituents. A number of the smelters have been in operation for many years and have experienced difficulties only comparatively recently.

"It is well known that mining and metallurgy are often the advance agents of civilzation and the pioneers in establishing industrial centers. In many localities the mines and the smelters supplied by them were essentially the only locators within great stretches of territory. Around them grew communities and cities dependent upon for a livelihood. Agriculture was of relatively small importance. But conditions changed with the increasing population of the country and the closer settlement of the West and, coincident with this increase, an agricultural industry has grown which, in the vicinity of the smelting plants, naturally suffers in some degree from smoke. Still, the area damaged is comparatively small and even this damage can be much lessened by the adoption of proper means. Since some plants have installed devices to remove sulphuric acid from the smelter smoke and have the smoke diluted with air, conditions have been much ameliorated in certain districts.

The damage that smoke can do depends largely on climatic conditions, especially the relative humidity of the atmosphere. The damage is much greater in regions having a moist than in those having a dry climate. In this respect such States as Montana, Utah, and Arizona are favorably located and smelters in those States can probably discarge gases richer in sulphur dioxide without doing damage than those in regions having a moister climate. For the same reason, the damage done at different seasons of the year varies. The moist atmosphere and the rains of spring and early summer conduce to increase damage to vegetation, particularly as at that time of the year the early crops and young vegetation are susceptible to serious injury.

"It has been customary to discharge the smelter smoke by means of very tall chimenys, on the assumption that it the noxious gases are discharged at considerable height they will have opportunity to diffuse more througly and thus become so diluted as to be comparatively harmless, but the efficiency of this method is now being questioned. There is reason to believe that the use of high stacks increases the area to damage, whereas low stacks may intensify the damage but concentrate it within a smaller area. Probably high chimneys do not serve their purpose as well as was anticipated, and at present the better method may be to dilute the smelter smoke and discharge it from a number of low stacks."

Copies of Bulletin 84 may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

PATIO

A new method of collecting precipitate from zince dust precipitation is controlled by the Merrill Metallurgical Co. It consistis in effecting the precipitation in a circular tank fitted with revolving mechanism and submerged filter leaves. The powder attaches itself to the surface of the filter leaves where the action upon the solution is continued. Arms similar to those of the Dorr thickener prevent an accumulation of material on the bottom. When it is desired to remove the precipitate from the filter, the flow of solution is stopped and the vacum turned off. The arms then discharge the material through a central opening in the bottom. The zinc dust is fed through jets in revolving radial pipes above the tank.

The work of the routine analytical chemist promises to be considerably simplified by the introduction by a supply company of "analoids," that is tablets containing the exact amount of reagent necessary for analysis by a given routine method. This saves the time and trouble involved in measuring reagents essential in accurate work.

An estimate has been made, based upon past experience, that the electrical industry doubles in volume every five years. Since the electrical industry takes fifty per cent of the world's production of copper, it is evident that the demand for copper is not likely to decrease.

A recent investigation leads to the conclusion that most missed holes are due to imperfect preparation of the fuse and cap. The fuse should be cut square with an instrument that does not mash the end, such as a sharp knife, a pair of sheep shears or best of all, a broad, thin, sharp chisel used with a mallet. The fuse should be inserted in the cap until the end is in close contact with the fulminate, and the cap closed with one firm squeeze with a crimper near the open end. If working where there is water in the holes the cap should be protected from dampness with grease or tar. The cap must under no consideration be crimped near the end, from ¼ to ½ in. being always left at the end. It is best to have one reliable man prepare all the fuse for the mine, one specially trained and selected for this service.

The action of a drill in cutting into rock is of three kinds—abrasion, crushing and chipping or severing. While all of these operate to a certain degree in all drilling, the greatest amount of useful work is performed when the percentage of force applied to chipping reaches the maximum.

Leadville, Colo., the old lead camp where the presence of zinc has given so much

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ASK FOR CATALOGUE.

trouble, is being rehabilitated, this time as a zinc camp. The ores do not yield readily to concentration and the zinc smelters will not consider materials carrying less than 20 per cent zinc. A new plant has been installed to manufacture zinc oxide pigment, taking ores containing as low as 14 per cent zinc. The process is a roasting one, the oxide being collected in bag houses and the non-volatile portions remaining on the grate as a sort of slag.

Many flotation processes are being placed on the market as well as a great variety of machines for the employment of the principles involved. A number of these machines have given marvellous results on copper ores, giving tailings as low as .08 per cent copper, this having been obtained in continuous runs lasting for several weeks and representing thousands of tons of material. The material for flotation seems to concentrate better in proportion to the fineness to which it is ground. In many mills 60 mesh pulp is the coarsest that is sent to the flotation machines.

The fuel economies resulting from the substitution of pulverized coal for the grate-fired furnace are surprising. With a grate-fired furnace and a similar furnace using the same coal in pulverized form, the fuel ratio in the first case was found to be 4¼ to 1; and in the latter case 7 to 1. The tonnage smelted in the pulverized fuel furnace was practically double that of the grate-fired furnace. These economies will, it is believed, result in the substitution of reverberatory for blast furnace smelting except in the case of exceptional ores. In most localities the reverberatory furnace will be able to do the work for about .75 per cent of the cost of blast furnace operation. This refers to copper smelting; for lead smelting no data are as yet available.

The present tendencies in copper metallurgy are summed up by E. P. Mathewson, of the Anaconda Copper Mining Co., as follows: Increased recovery in ore dressing; increased recovery of metals formerly lost in smoke and fume; reduced of operation, due to the introduction of larger smelting units and mechanical means for handling materials to and from furnices; the introduction of pulverized fuel for reverberatory smelting furnaces.

The latest furnaces of the reverberatory type for copper smelting have hearth dimensions of 25 by 144 ft., and have a capacity of 700 to 800 tons per day and a fuel ratio of better than seven to one. A still larger furnace is in course of construction, having a length of 175 ft. This furnace will take as part of its charge molten slag from the converts to be treated with raw concentrates to reduce the copper content. This furnace is expected to have a capacity of 1100 tons per day. Improvements in the reverberatory and its ability to handle fine material is profoundly affecting concentration practice on copper ores. Coarse jigging is being abandoned, nothing larger than ⅜ in. being now sent to the jigs.

Monazite sand is found in Brazil in commercial quantities only on the foreshore at certain points on the coast of the state of Espiritu Santo, and a few miles north of the town of Prado in the state of Bahia. The foreshore belongs to the government and leases are granted under the direction of the minister of finance. There are at present two active concessions and one passive.

PERSONALS.

Charles Hoyle, manager of the Esperanza Mining Co., El Oro, Mexico, was in Mexico City last month.

Jesse Scoby, formerly of Mexico, is managing director for La Luz y Los Angeles Mining Co., operating in Nicaragua.

R. B. Stanford is manager of the Bonanza mine in Nicaragua. Warren Stanford is superintendent of the cyanide plant.

A number of Canadian mining men were in Nicaragua investigating mines in the Pis Pis district. Among them were Samuel W. Cohen, general manager of the Crown Reserve Mining Co., of Cobalt and Eugene L. Steindler, secretary of the Dominion Reduction Works, of Cobalt.

Fred G. Farish is now manager of the Lluvia de Oro Gold Mining company's mines, in Chihuahua.

Allen B. Calhoun is now located at 714 Mills Bldg., El Paso, Texas.

W. H. Aldrich, mining engineer of New York, recently made a trip through the mining districts of Chihuahua.

H. V. Winchell, of Minneapolis, Minn., has been retained as mining expert for the Jumbo Extension Mining Co., of Goldfield, Nevada, in the apex litigation instituted against it by the Reorganized Booth Mining Co., of Goldfield.

Wm. Farrell, of Bisbee, Ariz., is operating a mining property northwest of Hermosillo, Son.

H. L. McKay is general manager of the Democrata Mining Co., Cananea, Son.

John Porter, recently of Zacatecas, is now at Calle Independencia No. 40, Mixcoac, D. F., Mexico.

C. A. Lantz has returned to Pachuca from the States.

C. B. Cleveland is a recent arrival in Mexico City from Los Angeles, where he has been for the past several months.

W. J. Graveling, assistant manager of the Republic Mining Co., is in El Paso, Texas, on company business.

Geo. W. Bryant has gone to the States.

S. J. Lewis, consulting engineer of the Chontalpam Mining Co., has returned from a visit to he property at Zacualpam, Mexico.

E. P. Herival, of the Esperanza company, is in Mexico City.

Juan Blanco, of Arteaga, Mich., is a recent arrival in the City.

Floyd Clark, was in Mexico City this month.

R. M. Raymond is in Chihuahua.

Dan B. Gillis is visiting Mexico City.

Arthur Hunter is here from Taxco, Guerrero.

TRADE NOTES

Mesta Machine Co., Pittsburgh, Pa.; This company has recently acquired the rights from the Stumpf Una-Flow Engine Co., of Syracuse, N. Y., to build the Stumpf Una-Flow type of engine in the United States.

Erie Pump & Engine Works, Erie, Pa.; This concern has been consolidated with the Northern Equipment Co., under the name of the Erie Pump & Equipment Co.

Sangamo Electric Co., Springfield, Ill.: Bulletin No. 40; 32 pages; illustrated, describes the construction of the Alternating Current Watthour Meters, Single-Phase and Pholyphase, manufactured by the Sangamo company. These instruments are built for voltages from 100 to 2200 volts.

Electric Storage Battery Co., Allegheny Ave. and 19th St., Philadelphia, Pa.: A 38 page booklet, illustrated, entitled "What Owners Say About "Iron-Exide Batteries," presents a large number of letters from users of these batteries giving opinions based on actual experience with them.

Manhattan Rubber Mfg. Co., Passaic, N.Y.: General Catalogue; 417 pages; illustrated, presents a large line of mechemical rubber goods, including belts, both transmission and conveyor; hose for water, oil, chemicals and varied uses; piston-rod, valve-stem, sheet and other packings. The company invites correspondence on special articles desired.

Denver Hydro Co., 876 Galapago St., Denver, Colo.; An illustrated 4 page folder gives details of the Denver hydro air compressor. It is claimed that this appliance is suitable for cheaply compressing air where one has an available mountain head of water of from 200 to 350 ft. This compressor is built in various sizes, four listed having air capacities of from 400 cu. ft. to 2000 cu. ft.

Morgan Engineering Co., Alliance, Ohio. This company has received an order from the Argentine government for a 150-ton short span gantry crane.

Chain Belt Co., Milwaukee, Wis., has issued Catalogue No. 56, of 303 pages, illustrated, dealing with elevating and conveying machinery, chain belts, sprocket wheels, transmission machinery, etc. The catalogue is well illustrated showing various products and many installations of them. The book is bound in cloth covers for permenent reference.

The Bristol Co., Waterbury, Conn., has recently issued a number of catalogues and bulletins describing and illustrating the recording instruments manufactured by the company.

Standard Steel Works Co., Philadelphia, Pa. Catalogue No. 9, 55 pages, illustrated, entitled Rings, Shells and Ring Dies; treats of the rings, roll shells and dies for crushing machinery, engines, etc., manufactured by the company. Special attention is called to the fact that all parts are made of forged and rolled steel. Illustrations show the following shells for crushing rolls: Straight bore, taper bore, double taper bore, shell recessed for draw bolts, special-bore shells. "Standard" roller tires and ring dies for Chilean mills; "Standard" Huntington mill roll shells and ring dies; "Standard" Griffin or Bradley mill rolls and dies; "Standard" Kent mill muller rings and ring dies; "Standard" Bryan mill tires and ring dies. Also lists wheels for locomotives and mine cars.

Davis Instrument Mfg. Co., Baltimore, Md., has for distribution leaflets descriptive of the sighting compasses, pocket mining hygrometers, water gases, and psychrometers manufactured by the company.

C. L. Berger Sons, Boston, Mass. A recent folder calls attention to the large stock of transits and other surveying instruments kept in stock by the company.

The Burd High Compression Ring Co., announces that their rapidly expanding business has made necessary more commodious quarters and that their general and executive offices have been moved from the Masonic Temple to 307-309 South Main St., Rockford, Ill.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1812	1913	1814	1912	1913	1814
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61 642	57 506	27.190	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59 207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58 175	28.038	27.825	26.704
June	61.290	58 990	58.471	28.215	27 189	26.948
July	60.654	58.721	54.878	27.918	27.074	25.219
August	61.608	58.283	54.344	28.375	27.335	25.878
September	83.078	80.640	53 280	28.088	27.886	24.260
October	83.471	80.793	50.654	29.299	28.083	23.188
November	62.792	58.885	48.082	28.012	27.263	22.703
December	83,365	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.560	19.606
March	4.327	3.870	4.177	3.850	15.977	19.851
April	4.381	3.810	4.242	3.683	17.597	18 225
May	4.342	3 800	4.226	3.863	18.923	18 503
June	4.325	3 800	4.190	3.810	20 226	19.411
July	4 353	3.891	4 223	3.738	20.038	18 051
August	4.824	3 875	4.550	3.715	20.408	
September	4.698	3 828	4.579	3.658	20.648	
October	4.402	3.528	4 253	3 384	20 302	
November	4.283	3.683	4.148	3.585	19 334	18.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14 672	61.603	14.871	.....	87.140	66.274
July	14 190	13.223	14 563	.....	64 166	64.955
August	15. 400	.....	15 804	.....	89 200	53.227
September	18 328	.....	18 789	.....	73 125	.....
October	18 337		18.913	....	73 383	.....
November	15 182	11.739	18 022	.....	88 275	.....
December	14.224	.....	14.904	.....	85 223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1931	1914
January	6.931	5.282	6.854	5.112	26.114 25.338	21.583
February	6.239	5.377	6.089	5.227	24.605	21.413
March	6.078	5.220	5.926	5.100	27.313	21.460
April	5.641	5.113	5.491	4.963	24.583	21.569
May	5.406	5.074	5.256	4.924	22.143	21.393
June	5.124	5.000	4.974	4.850	20 592	21.345
July	5.278	4.820	5.128	4.770	20.708	21.568
August	5.658	5.568	5.508	5.418	21.148	
September	5.684	5.380	5 444	4 230	20.614	
October	5 340	4 909	5.188	4.150	20.581	
November	5 229	5.112	5.083	4 882	21.214	25.018
December	5.156		.004			
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

TIN

Month	New York		London	
	1813	1814	1813	1814
January	50.298	37.779	238.273	171.905
February	48.766	39 830	220.140	181.555
March	46.832	38.038	213.615	173.818
April	49.115	36.154	224.159	183 883
May	49.038	33.360	224.143	150 702
June	44.820	30 577	207.208	138.321
July	40.260	31.707	183.511	142.517
August	41.582	.....	188.731	.....
September	42.410	32.875	193.074	.....
October	40.462	30.284	184.837	.....
November	39.810	33.304	180.869	139.391
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

AMERICAN SOCIETY OF MEXICO.

The Society of the American Colony of Mexico City has been reorganized on broader lines, under the name of "The American Society of Mexico."

At a mass meeting recently held in the City of Mexico a new Board of Directors was elected, together with the following named officers: President: R. M. Raymond; Vice President, Dr. Sidney Ulfelder; Secretary, J. D. Helm; and Treasurer S. S. Conger.

At a later meeting the Society adopted a new Constitution and By Laws, providing for permanent organization. This is broad in scope, to cover present and future needs.

The object of the Society as stated, is to promote the welfare of the American residents of the Republic of Mexico. Among other powers the Society is authorized to take cognizance of and act upon all subjects of general interest of its members; to promote and establish mutual cooperative relations; to cooperate with and assist other American institutions of Mexico; to provide, when expedient, a home or house for the accommodation of its members; and to acquire property when desirable for the uses of the Society.

All properly recommended nationals of the United States of America, either men or women residents of the Republic of Mexico, may become members of the Society by signing cards of registration.

The principal office of the Society is to be in the City of Mexico, but branch offices may be established elsewhere.

Heretofore the membership has been limited to men, but in the reorganization the women are invited to join. The present membership of about 1,300 will at once be largely increased.

A cordial invitation is extended to all Americans, men and women, throughout the Republic to identify themselves with this movement for mutual benefit. Naturally the Society will be non-political and non-sectarian. It is also entirely democratic and requires of applicants nothing more than a recommendation as to good character.

It is hoped that Americans of all occupations throughout the Republic will recognize the importance of such an organization and will identify themselves with it. If they do real benefits can be secured for all concerned.

There is need for a strong Society and better opportunities for acquaintance than have heretofere existed among the Americans so widely scattered over this great and undeveloped country. It is important that more and reliable information be had of the Americans living in Mexico, and that a common channel of communication be provided for various purposes. This will give an opportunity for united expression of sentiment and united action in matters relating to the common good. It will make possible a registration of American residents that has not existed heretofore.

When the plans are fully developed in the course of time the Society will be able to provide a Club or meeting place for Americans from all parts of the Republic when they visit the capital; meantime it can be made useful as a source of information to non-resident members.

All who feel an interest are invited to correspond with.

J. D. HELM, Secretary.

408 LA MUTUA, MEXICO, D. F.

The ordinary assay office is not usually equipped with a mechanical sieve shaker for making screen tests, and where tests must be made regularly the process becomes tedious and is apt to receive less care than it merits. For comparative results a uniform method of manipulating the screens both as to time and angle of inclination is essential. Mechanical shaking is then almost necessary. This difficulty has recently been overcome by mounting the nest of screens upon the laboratory crusher, the toggle of the crusher striking uniform blows against the bottom of the lower receiving pan and letting it fall upon the crusher frame. To give a side motion a strap-iron band encircles the lower pan and is attached by means of a connecting rod with the top of the oscillating jaw of the crusher. The exact length of connecting rod which will give the best results must be determined by experiment, care being necessary to have the motion the same on both sides to prevent banking of the material upon the screen surface. To prevent the rapid destruction of the pan bottom by the blows of the toggle, a piece of old belting is attached to the bottom to act as a buffer. With an apparatus of this kind run uniformly and timed accurately fair comparative results can be obtained.

No one can tell a miner from a distance how much powder he should use in a hole. This must be determined by experience or trial upon the kind of rock be broken and the kind of work to be done. Most miners prefer to play safe and use plenty of powder, and in that way frequently use from one half to a third more than necessary. It is always well to bear in mind that powder is expensive and also that the less you use the less the danger from it. In very dense hard rock it is often better to use a stronger explosive and less of it. This brings the entire bursting charge nearer the bottom of the hole where it belongs. In easily broken rock there is seldom any advantage in using an especially strong powder.

Sticks of tamping made of dry drillings wrapped in paper have been found very satisfactory. The tamping should contain no pebbles which would be likely to injure the fuse when rammed into place. It is not good practice to ram the tamping when working in soft or medium ground. Pressing it into the hole in the same way that the powder is introduced is usually sufficient, the expanding gases giving all the ramming required. In very hard rock the tamping must be well rammed to get good results, but even here there is no need of resorting to anything more drastic than the ordinary loading stick.

An interesting method of sampling old drill holes is in use in the Missouri zinc district. The old records are consulted as to the position of the ore. This being determined, sticks of dynamite are lowered and held in place in loops of a rope and exploded. The loosened material is hoisted out for a sample.

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La Aleación Oro-Cobre Expresada en Kilates.

A menudo se oye hablar de oro de tantos o cuantos kilates para indicar el título de la aleación oro-cobre, sin que muchos logren tener una idea exacta del número de partes de esos dos metales que entran en la aleación citada. De ahí que nos propongamos trazar un cuadro en donde se indique el número de partes de oro y de cobre que se necesitan para formar 1kg. de aleación, correspondiente a los diferentes títulos o kilates que existen.

Las consideraciones precedentes nos permiten trazar el cuadro que se inserta a continuación:

Antes recordaremos que se ha establecido por convención, que el oro completamente puro tenga un título de 24 kilates. El número de kilates de la aleación oro-cobre, sirve para indicar el número de partes de oro puro que entran en la aleación citada, y la diferencia hasta 24 kilates indica el número de partes de cobre puro. De ahí resulta, que cuando tenemos una aleación (de oro-cobre) de 23 kilates, por ejemplo, nos indica que está compuesta por 23 partes de oro puro y una parte de cobre puro.

La simple inspección del cuadro que antecede nos ofrece una ventaja: si conocemos el número de partes de oro y cobre que entran en una aleación dada, podemos saber inmediatamente cuál es el número de kilates de esa aleación y viceversa. Así cuando recordamos que 1 kg. del oro con que está hecha la libra esterlina está compuesto por 916,⁶⁶ gr. de oro puro y 83,⅓ partes de cobre puro, deduciremos inmediatamente que ese oro es de 22 kilates.

Importancia del Ensaye al Soplete en las Labores del Prospectador.

En este artículo tomaremos el oro y la plata juntos. Pésense cien milígramos, (1.5432 grains troy,) del material cuidadosamente muesterado y colóquese en el pequeño cucharon de cuerno teniendo cuidado de recoger con la brocha o cepillo todo el mineral del platillo de la balanza.

Los minerales que tienen grandes cantidades de azufre, arsénico, zinc o antimonio, después de pesarse necesitan de un tostado general antes de hacer la carga.

El método de torrificación del Dr. Richards de tostar es el mejor, y superior a todos los istemas expuestos en las obras de texto por lo que será el único sistema de tostar de que en estas experiencias hagamos uso. Este sistema necesita de un poco de más cuidado, pero economiza muchísimo tiempo. En un pedazo de carbón se perfora una pequeña cavidad con la barrena de carbón y el mineral se recoge con un cepillo cuidadosamente del cucharón y se extiende en toda la cavidad con la cuchara de marfil, de manera de formar una capa delgada y uniforme. Se le aplica luego una flama oxidante muy débil teniendo especial cuidado de que ninguna de las partículas se vuele.

Después de un poco de tiempo el material se habrá panificado ligeramente y en seguida se le aplicará una flama oxidante fuerte hasta que dejen de salir vapores o humos y olor a SO_2. Si esta operación se ha hecho cuidadosamente el material se habrá convertido en un pan el cual puede desde luego voltearse con la inserción cuidadosa de una navaja en cada uno de sus extremos y luego enrollarlo. El lado que quedó volteado se tuesta vigorosamente y cuando ya no se observen humos o vapores ni olores a SO_2 la muestra queda lista para la carga, se vuelve a colocar en el cucharón y se le mezclan los ingredientes correspondientes.

La carga variará según sea el mineral, siendo muy difícil dar reglas precisas para efectuar estas cargas, pero las instrucciones siguientes ayudarán muchísimo al operador en el desempeño de esas labores.

Atíncar.—La cantidad usada dependerá de la fusibilidad del mineral y de la cantidad de materiales que deberán escorificarse. Cien milígramos generalmente son suficientes. Si no obstante, el mineral es duro para al fusión, debido a la gran cantidad de hierro, cobalto o estaño contenido se le deberá agregar más bórax o atíncar durante el derretimiento de la carga.

Plomo granulado.—Por regla general es mejor usar más bien mucho que poco. La cantidad exacta que deberá usarse dependerá de los otros metales contenidos en el mineral.

Los minerales conteniendo menos del siete por ciento de cobre o diez por ciento de Ni necesitarán de 5 Zentner (500 mg.) de plomo granulado por cada 100 milígramos de mineral. Cualquier cantidad mayor de las antes citadas será cubierta por el empleo de 20 Zentner, (2000 mg.)

El telurio requiere la misma cantidad o sean 20 Zentners.

El speiss necesitará de 10 a 15 Zentners.

Los minerales conteniendo estaño necesitarán de 7 Zentners.

Bicarbonato de Sodio.—Este fundente se emplea con más frecuencia en los minerales ácidos y en pequeñas cantidades de Cu. El bicarbonato fácilmente forma escorias fusibles oxidando el hierro y el estaño el cual pasa luego a la escoria y actúa también como desazufrante. Las cantidades que deberán usarse dependerán grandemente de la naturaleza del mineral y de la función que el bicarbonato deberá desempeñar. Por tal razón casi siempre se emplea con minerales que contienen azufre, aún en el caso de que hayan sido previamente tostados.

La mejor carga en general para usarse en conección con los minerales que contengan oro y plata es la siguiente:

Mineral, 100 milígramos; plomo granulado 1,500 milígramos; atíncar 100 milígramos y bicarbonato de soda 50 milígramos.

Los ingredientes, después de haberse pesado o medido, el plomo granulado en su medida especial y el atíncar y el bicarbonato en la cuchara de marfil, (una cucharada igual a 100 milígramos), se vuelven al cucharón de cuerno con el mineral y se mezclan perfectamente quedando listos para la fundición.

La fundición.—Cerca de la punta de uno de esos pedazos anchos de carbón hágase un agujero no muy profundo y en él colóquese la carga envuelta en el papel de soda de manera que el fondo quede frente a la flama del soplete y el

* Traducción de un artículo del Sr. Siegfried Fisher.

costado del pequeño paquete descanse en el costado de la cavidad más lejana del extremo del soplete.

En seguida aplíquese una flama reductora, pero no muy fuerte cubriendo todo el ensaye con lo que se carbonizará el papel y derretirá la carga. Cuando todo se ha fundido se le aplicará una fuerte flama reductora. La mayoría de los metales y algunos juntos con el azufre y arsénico se unirán con el plomo y se fundirán en el botón. Los materiales terrosos lo mismo que los óxidos metálicos de difícil reducción y una pequeña cantidad de los metales fácilmente reductibles se derriten con el atíncar en la escoria.

Para asegurar una completa recolección del plomo el carbón vegetal deberá tenerse en movimiento hacia atrás y adelante. El plomo deberá estar todo en un botón y de la misma manera la escoria. Esta última deberá estar en un estado de fácil fusión. Si la escoria estuviese negra y pegajosa mostrará su estado básico, y por lo tanto deberá agregársele bórax. Si estuviese clara y fibrosa la escoria necesitará de más soda. Un buen botón de plomo deberá ser blanco. Si este fuere negro es que aun contiene azufre y deberá ser en tal caso oxidado. Esto se hace calentando el botón de plomo cuidadosamente con la punta de una llama fuerte oxidante. El óxido de plomo se irá con la escoria, pero no el oro o la plata.

Esta oxidación se continuará hasta que la superficie del botón de plomo esté de un color amarillo claro, debido a la delgada capa de óxido de plomo. No se le caliente mucho, o mejor dicho, no se le aplique una temperatura demasiado alta porque se derramará y se perderá parte de la ley. Cuando el botón tiene la apariencia correcta, el carbón vegetal se inclinará ligeramente para asegurar la recolección total del plomo fundido tratándolo con una flama reductora y vaciando la carga caliente en el yunque. Generalmente solo el plomo se vierte, permaneciendo en la cavidad la escoria. El plomo en el yunque se martilla formando un cubo y quedando luego listo para la escorificación.

La escorificación.—Esta es hecha en una copela. Llénese el molde de la copela con cenizas de hueso y comprímase con firmeza con la ayuda del martillo. Al quitarle la estampa deberá quedar la copela completamente lisa. Colóquese el molde en el agarrador, cójase el agarrador de madera entre el pulgar y el índice de la mano izquierda dejando que la parte plana del botón descanse en el dedo chiquito doblado de la misma mano. La copela se le libra de la humedad que contenga por medio del calor.

Cuando esté seco el pequeño botón se le coloca en el centro de la copela con un par de tenazas. Se inclina ligeramente hacia adelante la copela, en dirección al soplete, y se le aplica una flama reductora para reducir los óxidos de la superficie del botón hasta que se funda. En seguida el ensaye es tratado con una fuerte flama oxidante.

La escorificación deberá hacerse rápimente. El plomo formará litargirio el cual, parte es absorbido por la copela. Mucho de éste, sin embargo, permanece en la forma líquida al derredor del botón. Cuando la superficie del botón se ve como de tres milímetros de diámetro se deja que se enfríe la fundición.

Copelación Fina.—Usese una copela nueva que esté bien seca y colóquese el pequeño botón en ella de manera que quede cerca del filo izquierdo. Inclínese el agarrador de manera que el pequeño botón no se pueda enroscar hacia el soplete. Caliéntese el botón con una flama oxidante casi horizontal hasta que se derrita.

Cuando esté derretido quítese la flama del botón y caliéntese inmediatamente la ceniza de hueso que lo rodea haciendo que gire el sugetador con los dos dedos, de manera que el botón quede siempre en contacto con la superficie fresca de la ceniza de hueso. El botón de este modo describirá, al dar vueltas, una espiral al derredor del centro de la copela. El litargirio será absorbido por la copela y cuando se haya quitado el último vestigio del óxido el botón repentinamente brillará. Luego la operación queda completa.

Si solamente la plata fuere el metal contenido esta será la operación final y únicamente faltará pesar o medir el botón. Si el botón es grande podrá ser pesado y si es pequeño será medido con la escala Plattner. Un botón grande puede ser achatado en el yunque cortado en dos pedazos y cada uno puesto en la copela con plomo granulado y convertido a nuevos botones y luego medidos en la escala y combinados sus pesos. La operación de medir en la escala Plattner ya ha sido descrita.

Si el botón es una aleación de plata y oro se necesitará de otra operación llamada separación.

Separación.—Bajo este nombre se entiende la operación de separar el oro de la plata y generalmente se verifica tratando el botón por medio del ácido nítrico. El botón es colocado en un pequeño platito de porcelana y se le agrega a éste una gota de ácido nítrico concentrado y una o dos gotas de agua. Sujetando el platito entre el pulgar y el índice de la mano derecha se le inclina ligeramente, de manera de tener siempre el botón y el ácido en un sólo lugar; y luego lentamente se le calienta sobre una flama. Como el botón es atacado sobreviene un desarrollo de calor.

En esta operación nunca se tendrán las suficientes precauciones, porque si se verifica el derretimiento con mucha fuerza las pequeñas partículas de oro se escaparán del platito. Cuando cesa la actividad se le agrega agua. Luego es cuidadosamente decantado, o según la práctica del Dr. Richards, se doblará un pedacito de papel de tal modo que forme un ángulo agudo, y con la punta de éste se absorbe la solución.

Lávese de nuevo y repítase el tratamiento con ácido nítrico fuerte lavando finalmente dos veces.

De este modo queda el oro en una masa morena esponjosa. Si la reacción no hubiere sido muy viva todo quedará junto. Algunas veces el oro estará en varias partículas y esas deberán de juntarse todas. Para recoger el oro es mejor cortar un gránulo de plomo de la pieza sólida, ponerlo en la punta del forceps con la superficie limpia para abajo y luego hacer presión fuertemente con dicha superficie sobre las pequeñas partículas de oro, las cuales permanecerán sin dificultad en la superficie y fácilmente podrán recogerse.

Este plomo granulado conteniendo el oro es luego copelado y convertido en botón. He aquí una cosa que deberá tenerse siempre presente y es que no todas las aleaciones de oro y plata son atacadas por el ácido nítrico. He aquí una cosa que deberá tenerse siempre presente, y es la de que no todas las aleaciones de oro y plata son atacadas por el ácido nítrico. El botón deberá tener más que el 50 por ciento de plata. En la casa de moneda al costumbre es una tercera parte de oro y dos terceras partes de plata. Si el botón por su color demuestra que predomina el oro se le agregarán un poco de hoja o lámina delgada de plata para completar el radio correcto. El botón después de haber sido pesado o medido para precisar su peso total es envuelto en la cantidad necesaria de lámina de plata doblada en un pedazo de plomo granulado y copelado y convertido a botón y luego separado como antes se ha descrito.

El botón final de oro es pesado o medido. Si la aleación fué pesada la diferencia entre ella y el peso del oro dará el peso de la plata.

Si únicamente se ha medido, solo dará el volumen, pero no el peso. Todas las medidas en la escala de marfil darán el volumen y las cifras que dan el porcentaje o peso han sido calculado por el volumen. Como voy a describir la manera de emplear la escala del Dr. Richards, será por lo tanto innecesario describir el procedimiento de la escala de marfil, porque es similar a la del Dr. Richards.

En relación con esto hablaré del uso de la escala de Richards. El botón aurífero y la aleación de plata es colocada en la muesca varias veces y el diámetro es anotado. La lectura del máximo es la usada como correcta. En la tabla que acompaña a cada instrumento el peso de la plata es encontrado si el botón es todo de plata. Dividiendo este peso por la gravedad específica de la plata o sea 10.073 obtenemos el volumen de la aleación.

Después de la separación del botón de oro se mide otra vez de la misma manera. Su peso es dividido por la gravedad específica del oro dando el vo-

lumen del botón. Ambos volúmenes son expresados en milímetros cúbicos.

Substrayendo el volumen del oro del volumen de la aleación da o resulta el volumen de la plata.

Multiplicando los correspondientes volúmenes por la gravedad específica del oro y de la plata darán los correspondientes pesos de los dos metales de los cuales las onzas o porcentaje pueden ser calculados.

Ejemplo:

Aleación $\frac{\text{mg. de plata.}}{\text{Gravedad esp. de la plata}}$ volumen de la aleación en milímetros cúbicos.

Oro $\frac{\text{mg. Oro}}{\text{gravedad esp. del Oro.}}$ volumen del oro en milímetros cúbicos

Volumen de la aleación—volumen del oro=volumen de la plata en milímetros cúbicos.

Volumen de la plata×la gravedad específica de la plata=al peso de la plata en milígramos.

Volumen del oro×la gravedad específica del oro=al peso de oro en milígramos.

Para la conversión de los milígramos en onzas véase la descripción de la escala de Plattner.

Precauciones en los ensayos de plata y oro.—Si el telurio no se ha excluido por completo se irá al botón plomoso y en la copelación final demostrará efectos nocivos. Esto hace bajar la tensión de la superficie del plomo y hace que se desparrame formando glóbulos por separado cada uno de los cuales contiene algo de las leyes. Estos pequeños botones no pueden ser colectados, por lo cual es necesario evitar este efecto con la adición de suficiente plomo granulado a la carga inicial.

Es esencial que el pequeño botón de plata o de aleación sea enfriado lentamente para evitar que florezca, debido a la absorción del oxígeno mientras está caliente, el cual es liberado de nuevo inmediatamente antes del enfriamiento ocasionando una pérdida por el derretimiento.

Si durante la copelación se afloja alguna de la ceniza de hueso, esta a veces se junta en el botón. Cuando esto ocurra tómese un poco del plomo granulado y colóquese en el botón y fúndase. Este se fundirá junto con el botón aumentando la masa del mismo e inclinando la copela el botón se librará por sí sólo de la ceniza de hueso.

Si contuviera mucho cobre en el ensaye una copelación sola no es suficiente. Más plomo granulado deberá agregársele al botón durante el procedimiento y la copelación se repetirá hasta que el botón quede libre del cobre. Si aun persistiese el cobre después de la primera copelación, el botón tendrá una apariencia achatada y a ratos mostrará algunas manchas o gotas de óxido de cobre.

El calentamiento es otro factor importante en la copelación fina. Si el botón es calentado a alta temperatura la plata se volatilizará. Si no es suficientemente calentado, el litargirio alrededor del botón se solidificará y se pegará a la copela. El calentamiento deberá de ser de tal modo que el litargirio sea absorbido con rapidez por la copela.

La separación del botón de la copela requiere algún cuidado y para evitar la pérdida del botón es siempre conveniente trabajar o verificar esta operación sobre una hoja de papel con las orillas dobladas hacia arriba formando una especie de charola.

Cuando el botón ha sido enfriado en la copela éste deberá ser despegado cuidadosamente de ella con una navaja y enseguida cogido con el forceps, de manera de no ejercer una presión demasiado fuerte al cogerlo, que pueda cambiar la forma casi esférica del gránulo. El botón también podrá separarse de la copela con las tenazas para botones, pero siempre y en todo caso deberá tenerse presente que su forma se conservará a toda costa. El botón se limpia después totalmente quitándole toda la ceniza de hueso que pudiere tener frotándolo suavemente con la punta del dedo y un pedazo de papel de filtro o bien con un cepillo.

El ensaye de cobre.—En esta operación se desea siempre retener el cobre durante el proceso de fundir. Si el mineral contiene azufre, arsénico o antimonio en tal caso el mineral deberá de torrificarse y después pesarse la muestra. Para el ensaye se usan cien milígramos de mineral y éste se mezcla con 5 Zentners de plomo granulado y suficiente bórax para hacer una escoria de fácil fusión. Mézclense los ingredientes de la carga y hágase en el papel de soda, fundiéndose en el carbón vegetal como antes se ha descrito.

La escoria deberá tener un color negro y no mostrará ninguna coloración roja. Si se le viere algún color rojizo a la escoria será por razón de que el cobre ha sido oxidado y deberá reducirse o convertirse de nuevo a cobre metálico enrollando el botón en la escoria bajo la acción de la flama reductora. Otro método para conseguir el mismo resultado consiste en agregar un pedazo de plomo granulado al ensaye. Este plomo al fundirse junto con el botón, cogerá todo el cobre reducido y el proceso puede continuar.

Si el bórax se pega al carbón vegetal auméntese el calor de la flama reductora. Cuando ya se haya fundido toda la carga y todo el metal se haya colectado se vierte en el yunque y se martilla convirtiéndolo en botón.

Hágase un nuevo agujero en el carbón vegetal y colóquese el botón en él con ácido bórico cristalizado. Como éste se funde con más dificultad que el bórax se requerirá una flama más caliente. Fúndase primero con una flama reductora y luego oxídese. El plomo forma un borato de plomo de color verdoso y de muy fácil fusión. Si existiere algún color rojizo significará que ha habido allí una pérdida de cobre.

Para quitar el cobre de la escoria si se hubiese perdido algo en esta forma, aplíquese la flama reductora al mismo tiempo que se hace girar el botón en la escoria hasta que la coloración roja haya desaparecido. La pérdida del cobre puede observarse inmediatamente en la escoria que tendrá en tal caso un color rojo-lacre en la luz de la flama luminosa.

La escoria deberá de tenerse siempre fluida y durante todo el tiempo que dure esto debe de tenerse la seguridad de que el botón está en forma líquida. Cuando la escoria principia a hacer burbujas esto significará que la cantidad máxima de borato se ha formado. Cualquier calentamiento en exceso o después de formarse las citadas burbujas no ayudará en nada la operación y además el carbón vegetal reducirá algo del plomo contenido en la escoria, a plomo metálico.

Cuando empiece el burbujeo déjese solidificar el botón y mientras esté la escoria en estado pastoso quítese el botón con el forceps y sumérjase en agua la cual se tendrá encerrada en uno de los platitos de porcelana chicos. Esta inmersión en agua, limpia el botón de la escoria que se le haya adherido. Séquese en papel de filtro y colóquese el botón en un lugar nuevo en el carbón vegetal con ácido bórico fresco y oxídese cuidadosamente. Repítase esta operación tantas veces como sea necesario.

Cuando el contenido plomoso gradualmente disminuya, el botón se dificultará más fundirlo. El color del plomo desaparece y en su lugar aparecerá el color del cobre. El botón fundido adquirirá una coloración verde nilo cuando se haya llegado al cobre. Al enfriar el metal que quedó tendrá un color salmón si es puro.

Si el botón es terminado deberá ser maleable y cuando se aplane en el yunque no deberá mostrar grietas o aberturas a lo largo de los cantos. Si los cantos u orillas muestran grietas el botón deberá ser tratado otra vez con ácido bórico y probado nuevamente. Después de asegurarse uno mismo de la pureza del botón metálico, se pesa éste y si el mineral contiene solamente el cobre como ley, la operación se ha terminado.

Si contuviere plata y oro el mineral, estos metales se encontrarán también en el botón de cobre. Después de pesarle se le lleva a la copela con plomo granulado y se le copela finamente. Ese botón así contendrá el oro y la plata y será medido o pesado. Su contenido aurífero será determinado por la separación y los resultados interpretados como está descrito en la parte respectiva de este artículo con la denominación de plata y oro.

Con un poco de práctica y cuidado no se necesitará hacer ningún agujero en el carbón vegetal para el tratamiento con el ácido bórico. Simplemente colóquense algunos cristales de ácido

bórico en la superficie plana del carbón vegetal y fúndase. En seguida colocar el botón en el ácido fundido y tratarlo como ya se ha descrito arriba. Este método economiza tiempo y puede uno observar mejor el desarrollo del procedimiento.

Ensaye de Cobalto y Nikel.—Esos metales, lo mismo que el hierro deben sujetarse al arsénico para facilitar su determinación cualitativa. Si también el cobre se encontrare presente éste podrá ser obtenido también como arseniuro. Por regla general los minerales que contienen níkel también contienen cobalto y viceversa. Esta operación está basada en el principio de que cuando esos metales ocurren juntos ellos pueden ser oxidados con éxito en presencia del bórax, yendo el hierro primero, luego el cobalto, el níkel y el cobre.

Los minerales de hierro, níkel y cobalto, pero no en la forma de arseniuros deben primeramente arsenicarse, lo cual se hace mezclando cien milígramos del mineral con cien milígramos de arsénico pulverizado envolviendo la mixtura en un papel de soda y colocando la cápsula bien apretada y empacada en el tubo de probar calentando éste cuidadosamente en flama no luminosa, en lámpara de alcohol, primero con llama lenta y después gradualmente aumentar la temperatura hasta hacer que el tubo llegue al rojo. El tubo deberá voltearse en su eje para vitar que la carga en el papel de soda se adhiera al vidrio. Se formará un espejo de arsénico en los costados del tubo de prueba y cuando éste ya no parezca que crece más, la operación se ha completado. El papel usado conteniendo la carga ya arsenicada se vacía en el cucharón de cuerno para mezclarse con los otros ingredientes.

El método de proceder es como sigue: Se pesan cien milígramos de los minerales si se necesitara arsenicarlos, si no mézclense directamente con cincuenta milígramos de bórax y 15 milígramos de soda, de otro modo, después de arsenicar, envuélvase en papel de soda y redúzcase en el carbón vegetal hasta que se funda y el metal se colecta en un botón.

En seguida úsese flama oxidante y quítese, primeramente, el hierro por la oxidación continua en presencia del bórax fundido. Siempre que se encuentre presente el hierro, la escoria mostrará una coloración verde muy clara y al dejar que se enfríe el botón, éste mostrará una superficie negra debido á la oxidación del producto del hierro y arsénico, probablemente un compuesto básico. Si contuviere mucho hierro el tratamiento con bórax fundido deberá ser repetido al igual que el tratamiento del cobre con ácido bórico. Cuando ya casi todo el hierro se ha ido el pequeño glóbulo metálico al enfriarse será cubierto con óxido de hierro.

Al último el botón de metal mostrará una apariencia metálica y luego será removido y después de liberarlo de la escoria que se le hubiese adherido, el botón está ya exento de hierro y será sin bórax y tratado con la flama reductora hasta que no dé más arsénico. El botón está ya excento de hierro y será pesado. Un peso de cien milígramos de botón dará la cantidad de Fe_2 As_2.

El residuo del botón será tratado nuevamente con bórax en la flama oxidante. La escoria ahora mostrará la coloración azul del cobalto y el botón al enfriarse mostrará una iridescencia rosada. Si contuviere mucho cobalto el tratamiento con el bórax se repetirá separando el botón cada vez sumergiéndolos en el agua y librándolo de la escoria por medio de frotaciones y después colocándolo nuevamente en el carbón vegetal con bórax fresco.

Como ya casi es el fin de la operación y el cobalto ha sido eliminado casi en su totalidad, el color rosado del botón desaparece y el botón será difícil conservarlo derretido.

Cuando al pellizcarse la escoria pastosa entre el forceps de platino y al elevarse se vea un color purpurino y el botón al enfriarse muestre un tinte verde de manzana es que todo el cobalto se ha eliminado. El botón se limpia y se pesa. Luego 100 mgs.—Fe_2 As_2—peso del botón dará la cantidad de Ni_2 As.

Si el último peso es todo de Ni la operación se habrá concluido siendo así el peso del botón Ni_2 As. Pero si el níkel que quedó también contiene cobre, oro y plata será mejor, en tal caso, proceder de la siguiente manera: derrítase el botón con igual cantidad de plomo granulado y trátese con ácido bórico como en el cobre. El níkel es oxidado simultáneamente con el plomo con ninguna o muy pequeña pérdida. Cuando el botón muestre las características del enseye éste es pesado dando el peso del cobre, oro y plata.

Precauciones.—Al calentarse siempre trátese de mantener la escoria derretetida fundiendo el botón y luego teniendo la flama en la proximidad o cercanía de él en la escoria. Es mucho mejor para el principiante hacer una pequeña cavidad en el carbón vegetal y derretirlo, por necesitarse de gran experiencia para verificar la oxidación directamente en la superficie del carbón. El botón tiene una tendencia a enrollarse a lo largo del filo de la escoria y a menos que se tenga mucha vigilancia se enrollará si no está en una cavidad o hueco.

Los compuestos formados y pesados son los siguientes:

Fe_2 As_2 52.8 por ciento Fe.

Co_2 As 61.1 por ciento Co.

Ni_2 As 61 por ciento Ni.

(Cu+Ag+Au)—Ag+Au=por ciento

(Ag+Au)—Au=Ag.

(Ag+Au)—Au=por ciento de Ag.

100 mg.—Peso de Co, Ni, etc. botón Fe_2 As_2×0.528= por ciento de Fe.

A mg. —Peso de Ni, etc botón Co, As ×0.611=por ciento de Co.

B mg. —Peso de (Cu+Ag+Au) etc. botón Ni_2 As×0.610=por ciento Ni. de Cu.

El ejemplo usado es el más complicado por incluirse seis metales.

Si no contuviere hierro el primer botón obtenido será metálico en apariencia y la escoria acusará ligeras pérdidas del metal contenido. Un tinte azul acusará cobalto y un tinte moreno-humo mostrará níkel. Se tendrá gran cuidado en el primer deretimiento de usar una pura flama reductora para disminuir todas las pérdidas posibles. El color del botón es también un conducto seguro para juzgar qué metal se tiene en la mano indicando el color rosado y el blanco níkel.

Ensaye de Mercurio.—El ensaye de mercurio es muy sencillo. Se pesan 0.5 milígramos del mineral, se mezclan con 1 gm. de litargirio y cuidadosamente se cepilla introduciéndolo en un tubo de vidrio como de 19 centímetros de largo por 6 milímetros de diámetro. Este tubo de vidrio deberá estar cerrado en uno de sus extremos y doblado en ángulo de más de 45°.

El tubo de vidrio se prepara de la siguiente manera: se toma un vidrio de un tamaño como del doble que se necesite caliéntese en el centro y estírese con lo que quedarán los extremos que se estiraron con una forma puntiaguda por lo que después se volverán a calentar para redondear los citados extremos. Uno de los tubos cerrados derechos se le encurva en las dos terceras partes de distancia del extremo abierto calentándolo en el lugar indicado en una flama luminosa haciéndolo girar al mismo tiempo el citado tubo lentamente. Después de poco tiempo el tubo se ablanda doblándose entonces en la forma deseada fácilmente. Para evitar que se quiebre es bueno conservar la superficie que se calentó cubierta con hollín de la flama hasta que se enfríe.

Antes de colocar la carga en el tubo deberá ser calentada con el objeto de quitarle la humedad y para evitar que la carga se pegue en la parte derecha del tubo de vidrio. La carga se pone dentro del tubo con más facilidad doblando una tarjeta o un papel a lo largo poniendo la muestra en él y moviendo el papel cuidadosamente dentro del tubo, teniendo presente al hacer esta operación que es necesario recoger con dado adheridas al papel. Si la parte de un cepillo las partículas que hayan quela carga se adhiriera al tubo una pequeña brocha o pincel de pelo de camello servirá perfectamente para separar las partículas. La carga citada es seguida de una buena capa de litargirio.

Cuando el tubo esté listo para calentarlo, la parte recta de éste deberá estar completamente limpia. Un pedazo de papel de filtro flojo colocado en la boca del tubo absorverá cualquier humedad que contuviere aún la carga. El extremo cerrado del tubo es luego calentado cuidadosamente, lentamente pri-

mero porque pudiere existir algo de humedad en la carga la que al ser calentada fuerte y repentinamente arrojará el litargirio hacia la parte recta del tubo y hará que se pierda el ensaye. Cuando toda la humedad haya sido expelida se calentará la carga hasta fundirla. El El mercurio habrá sido purificado y recogido en forma metálica en la parte recta del tubo.

Déjese enfriar y téngase cuidado de conservar horizontalmente la parte derecha del tubo de manera de que no se pierda parte del mercurio. Córtese el tubo con una lima precisamente en la parte curva, colóquese en el yunque y quiébrese la parte que contiene la carga. Es conveniente en esta parte colocar un pequeño platito de porcelana bajo el extremo abierto del tubo con el objeto de recoger todo el mercurio si algo de él se pudiere caer.

Cuando el extremo doblado del tubo haya sido cuidadosamente separado inclínese el tubo de vidrio sobre el platito de porcelana y con un pincel de pelo de camello pegado a un palito o a una varilla de vidrio júntese el mercurio dentro del mismo. Antes de quitar el pincel désele ligeros golpecitos con el objeto de que se le caiga todo el mercurio que se le hubiere adherido y que éste caiga dentro del platito. El glóbulo de mercurio deberá estar limpio y exento de litargirio, siendo luego pesado dando la proporción de mercurio en el mineral.

Es mejor pesar el mercurio envuelto en un pedazo de papel previamente pesado para evitar la amalgamación con el metal del platón de la balanza. Este método puede usarse para todos los minerales sulfurosos conteniendo mercurio con la excepción del idrialite, una mezcla de cinabrio, arcilla, yeso, piritas y materias bituminosas, las cuales expelen materias volátiles contaminando el mercurio. Para cloruros la misma carga es usada en adición de la soda siendo la cantidad de este ingrediente tres veces el peso de los minerales siendo el método para proceder enteramente el mismo.

Conclusión.—Existen más determinaciones cuantitativas posibles tales como las del estaño y plomo, pero esas carecen de la exactitud que poseen las arriba mencionadas y por esta razón simplemente voy a hacer referencia al lector del libro que ofrece la mejor información sobre esta materia, el cual es "Análisis Cualitativo y Cuantitativo con el Suplete," traducido por Henry B. Cornwall y publicado en inglés por D. Van Nostrand Co. de Nueva York, E. U. de A.

Es interesante el saber que con la ayuda del soplete se pueden determinar humedades lo mismo que análisis de carbones de piedra. Sin embargo, esto es de menos utilidad al prospectador. Para el joyero, los ensayes de soplete le pueden servir para determinar la composición de las aleaciones, pero el uso principal del análisis cuantitativo de soplete reside en el trabajo del prospectador por ser un medio rápido y sencillo de obtener resultados economizando tanto dinero como tiempo.

Finalmente citaré unos cuantos ejemplos demostrando la exactitud de los diferentes métodos cuyos resultados han sido obtenidos por diferentes personas sobre los mismos minerales.

Mineral muy rico de plata de difícil trabajo.

Ag.....2.43 mg.....	trabajado en	1902
,, ...2.43 ,,.....	,,	,,	1903
,, ...2.45 ,,.....	,,	,,	1903
,, ...2.45 ,,.....	,,	,,	1904
,, ...2.44 ,,.....	,,	,,	1911

Ensaye de Oro, Plata y Cobre.

Cu.22.0 Ag.24.2 Au.53.8	trabajado en	1906
Cu.22.0 Ag.24.2 Au.53.8	,,	,,	1912

Hierro, Cobalto y Níquel.

Co.....10.8 Ni....13.2	trabajado en	1910
Co.....10.8 Ni....13.5	,,	,,	1910

Mineral de Garnierite:

Ni.....6.1%	trabajado en	1896
Ni..... 6.0	,,	,,	1902
Ni.....6.1	,,	,,	1914

Speiss de Arsénico.

Fe_3As_2..38.0 Co..7.6 Ni..7.7	trab. en	1911
Fe_3As_2..36.9 Co..8.0 Ni..7.6	,,	,,	1911
Fe_3As_2.. — Co..7.9 Ni..7.6	,,	,,	1914

La inexactitud aquí expuesta no es tanto debido al método sino a la inexperiencia del practicante, no obstante que en la determinación del hierro existirá siempre más o menos variación debido a los posibles cambios de pérdidas en la operación.

Cuprita y Bornita cuarzosa:

Cu.....30.0%.....	trabajado en	1901
Cu 30.0	,,	,,	1903
Cu.....30.0	,,	,,	1905

Azurita:

Cu [electrolítico]....48.2%	,,	,,	1911
Cu [soplete] 48.1	,,	,,	1911

Cinabrio de la Península Malaya.

Hg.....51.8%.....	trabajado en	1911
Hg.....52.0	,,	,,	1911
Hg.....52.3	,,	,,	1814

Los resultados más exactos son obtenidos con los ensayes del oro, plata y cobre, pues los otros, especialmente el hierro, cobalto y níkel se necesita para practicarlos debidamente de mucha práctica. Considerando la cantidad de trabajo que generalmente hace el ensayador para el prospectador para obtener sus informes respecto a las posibilidades o leyes de sus minerales, uno puede observar que el tiempo que se pierde en adquirir los conocimientos para desarrollar y perfeccionarse en estos métodos de ensaye muy pronto es compensado, por los resultados obtenidos con esos métodos que son ciertamente exactos, lo suficiente al menos para darle al prospectador una idea muy aproximada del valor o ley de sus minerales.

La Minería en Tepic, México

De un periódico que se publica en Guadalajara tomamos el siguiente suelto que nos informa de la minería en Tepic. Muchas zonas del país se encuentran en parecidas condiciones a las que nos da a conocer el colega citado, y por lo mismo se hace sentir la necesidad de la construcción de ramales de ferrocarril o carreteras, que den salida a los ricos y abundantes productos que pueden encontrarse en la región.

Se impone también la baja de las tarifas ferroviarias, en los lugares donde ya hay líneas, especialmente en la que se contrae al transporte de mineral porque, como lo hemos dicho en otras ocasiones, en la generalidad de los casos, la ley del metal es baja, compensándose esta deficiencia con la abundancia del producto y la facilidad de la extracción. Pero estas condiciones requieren naturalmente la baratura del transporte.

Aunque es indudablemente un gran país minero extensamente mineralizado, de condiciones geológicas muy favorables y variadas, con gran número de antiguas minas y excelente prospecto de las nuevas; la minería en Tepic lo mismo que en el resto del país no ha progresado hasta hoy por falta de medios de transporte, y en consecuencia, no habiendo recibido atención especial ni mucho menos de los mineros, guardan aquellas casi el mismo estado en que estaban cuando los españoles las abandonaron en 1810.

No es sino hasta hace diez y ocho meses, cuando se arregló en definitiva que el Southern Pacific tocara en Ixtlán cuando se despertó el interés por las minas y se denunciaron gran número de pertenencias por parte de nacionales y extranjeros; pero sin que hayan introducido éstos los métodos modernos. Los valores se han asegurado por los métodos antiguos y costosos. El mineral no rinde más que tres kilos por tonelada (sin contar el valor del oro) y los productos no se consideran como metales de explotación.

Ixtlán está situado en el fértil valle del mismo nombre, a 3,800 pies sobre el nivel del mar en el camino de Tepic y San Marcos, términos del ferrocarril Central Mexicano. Una diligencia corre diariamente entre San Marcos y Tepic por la vía de Ixtlán.

Respecto a situación geográfica, Ixtlán es un distrito ideal. La zona mineralizada es muy extensa. Al Sur de dicha población se alza la gran cordillera en donde está la montaña llamada Cerro Alto, cuya altura sobre el nivel del mar alcanza a 9,600 pies.

La formación de rocas es variada, pero consiste por lo general en roca rudimentaria profundamente alterada y abierta por numerosas intrusiones de rocas plutónicas principalmente pórfidos y mármoles.

Condiciones Geológicas de la Región Norte de la Costa Occidental de la Baja California, Mex.

(Continuación) *

Sobre el Cretáceo se encuentra igualmente, en capas horizontales, el Terciario. Este se compone principalmente de areniscas claras friables, margas amarillentas y de considerables depósitos de conglomerados. La distribución del Terciario coincide en el Norte de nuestra zona con la del Cretáceo superior, es decir, que desde la frontera con los Estados Unidos hasta el Rosario, encontramos el Terciario cubriendo en lo general únicamente el Cretáceo y no las rocas más antiguas. Por lo pronto hemos reunido aquí los conglomerados con los depósitos de areniscas y margas terciarias aunque esto no está justificado por el hallazgo de fósiles. Los conglomerados están siempre encima de las areniscas y margas, y es muy posible que pertenezcan en su totalidad o en parte ya al Cuaternario. Estos conglomerados tienen una distribución algo diferente de la de las areniscas y margas, se extienden mucho más; los hemos encontrado en muchas partes sin las areniscas y margas cubriendo directamente rocas más antiguas y no sólo esto sino los hemos observado también en el interior de la Península, por ejemplo, en los bordes del valle de Real del Castillo.

La distribución del Terciario y de los conglomerados cambia bastante en el Sur. Desde los alrededores del Rosario vemos el Terciario y principalmente los conglomerados mencionados arriba extenderse hacia el interior de la Península. Los conglomerados contienen aquí en su base con frecuencia fósiles mal conservados de aspecto muy moderno; en la parte superior no hemos podido encontrar restos orgánicos. En la subida del Rosario para San Fernando, encontramos tales conglomerados cubriendo el pórfido. En los llanos de Buenos Aires (cerca de la ex-misión de San Fernando) hemos observado areniscas friables y arenas cubiertas por conglomerados y parece que estas rocas se extienden bastante hacia el Este. Entre el cañón de San José y los Sauces, vemos que el granito y el pórfido está cubierto por areniscas friables, claras y conglomerados en estratificación horizontal; estas capas no son muy potentes, pero aumentan rápidamente en potencia hacia el Sur. Restos de esta cubierta de areniscas terciarias encontramos también sobre los granitos, etc., más al Este del cañón de San José en el camino del Onix de Cerro Blanco, a la laguna de Chapala, donde pasan al lado oriental de la Península.

* Parergones del Instituto Geológico Mexicano.

Las condiciones al Sur de la región descrita brevemente aquí, son completamente idénticas; sólo que la potencia de las rocas terciarias aumenta bastante. En dos lugares más hemos podido observar que el terciario marino pasa al lado oriental de la Península, a saber: en el puerto de San Juan (San Borjas) y en el de Santa Isabel (cerca de Calamahí). En estos lugares coronan los depósitos terciarios la cumbre de la sierra granítica que forma el espinazo de la Península. Las rocas terciarias tienen aquí una potencia de unos 300 m. y quizá más.

Esta extensión de las rocas terciarias de una costa de Baja California a la otra pasando sobre las crestas más altas, nos indica que aquí en el Sur se hundió de nuevo todo aquel terreno que durante el Cretáceo superior se había levantado sobre el nivel del mar. Parece que este enorme hundimiento comprende toda la región al Sur de la sierra de San Pedro Mártir (el límite todavía no se puede precisar con exactitud), mientras que esta misma quedó en su lugar o por lo menos no bajó tanto como los terrenos meridionales.

La distribución de los conglomerados de los cuales no podemos aún decir si son terciarios o cuaternarios, en la parte septentrional de la Península, indica que durante el depósito de ellos siguió el hundimiento de aquella región, de modo que el mar penetró hasta el interior de la Península. Desgraciadamente no nos fué posible estudiar también el interior de la Península respecto a la solución de este problema y así no nos es posible determinar con alguna exactitud los límites del hundimiento discutido.

Al citado hundimiento debe haber seguido durante el cuaternario y quizá del período reciente un levantamiento general. Esto nos lo indican las rocas eruptivas modernas que cubren los conglomerados terciarios o cuaternarios en muchas partes de la región estudiada por nosotros. Estas rocas forman en parte corrientes y en otros conos volcánicos. En las costas del Pacífico hemos encontrado únicamente basaltos, en el lado del Golfo de California también andesitas. Del carácter de estas rocas se puede deducir que la erupción no ha sido submarina sino en tierra firme; en algunos puntos hasta nos ha sido posible encontrar el lugar donde la lava entró al mar. Durante el tiempo de estas erupciones la forma de la Península ha sido seguramente todavía muy diferente de la actual, lo que indican algunos lugares en los cuales se ve que el centro de las erupciones debe estar en un punto que hoy día está cubierto por el Océano.

Podemos distinguir varios distritos grandes de erupciones basálticas. El más septentrional ocupa la región de la costa entre la Mesa Redonda y el Sauzal (al Norte de Ensenada). El basalto cubre aquí casi toda la zona formada por el Cretáceo superior y el terciario. Seguramente todas estas corrientes de lava no han salido de un solo centro sino de varios, de los cuales fué uno de los más importantes el cerro del Coronel al Sur de la Mesa Redonda.

Otro distrito de erupción basáltica comprende la región entre el cabo de Colnett y San Quintín; actualmente está la corriente de lava de cabo de Colnett separada de los volcanes de San Quintín, pero como ya lo hemos indicado en la discusión de las condiciones del fondo del mar, hay mucha probabilidad de que la corriente de cabo de Colnett esté conectada con los volcanes y las corrientes de basalto de las lomas de San Quintín.

Otro distrito grande se encuentra entre el Rosario y la punta de Canoas. Allí están las altas mesas del Cretáceo superior y Terciario cubiertas por varias corrientes de basalto, sobre algunas se levantan tambien cráteres de una altura no muy grande.

Desde una línea que atraviesa la Península aproximadamente desde el cañón de San José hacia el Este, se encuentra basalto casi en todas partes cubriendo los granitos, los pórfidos y el Terciario, y extendiendose desde la costa del Pacífico hasta el Golfo de California. Esta región de erupciones basálticas comprende todo el terreno entre la mencionada línea y Calamahí; probablemente sigue todavía al Sur. Naturalmente no se trata de una sola corriente sino de muchos centros y distritos de erupción, pero en nuestro viaje rápido que solamente se hizo por dos caminos, no nos fué posible determinar los límites de los diferentes distritos que de por sí serán muy numerosos. Como cosa notable debemos mencionar la región volcánica entre el cañón de San José y los Sauces que está cubierta de numerosos cráteres; en un solo día de viaje pudimos encontrar 10 conos basálticos; la llamamos la región de los volcanes de las Lagunas Secas.

De los llanos entre el arroyo de San Xavier y Ojo de Liebre, se levantan en diferentes partes conos volcánicos aislados. El más grande será el del Picacho que se encuentra cerca del arroyo de San Xavier, otros son el cerro de Santo Domingo y un pequeño volcán que se en-

cuentra al Oeste de Campo Alemán. El resto de una corriente de basalto o de un cono de lava lo forma la Loma María entre Santo Domingo y el arroyo de San Xavier. Cosa semejante parece ser también el Cerro Perdido, al Sur del camino de Santo Domingo a Calamahí.

Regiones de enormes acumulaciones de basalto las encontramos en las sierras del Paraíso y de San Luis, ambas al Norte y Noroeste de Calamahí. Allí hay lugares donde las corrientes y acumulaciones alcanzan un espesor de 100m. y más.

En la vertiente del Golfo de California, entre el puerto de Santa Isabel y el puerto de San Juan (San Borjas), hemos encontrado también corrientes de andesita en parte con intercalaciones de obsidiana. Esta obsidiana fué utilizada por los indios primitivos de Baja California para la fabricación de flechas, lanzas, cuchillos, etc., hemos encontrado en numerosos puntos restos de tales armas de obsidiana. La andesita se encuentra en la mencionada región entre el terciario y la corriente de basalto. Según las observaciones de los geólogos americanos Emmons y Merrill se encuentran andesitas también más al Norte en la region cerca del Golfo de California, es decir, cerca de las canteras del Onix, al Este de Buenos Aires; es, pues, posible que en aquella zona que acompaña la costa del golfo existen varios centros de erupciones andesíticas.

Encima de las capas descritas aquí se encuentra particularmente en la región meridional de nuestra zona otro depósito, ciertamente no de una potencia muy grande, pero de suma importancia para la historia geológica de la Península. Es un depósito que se compone generalmente de arenas y médanos, en aislados casos también de conglomerados; todos estos depósitos contienen numerosos restos de conchas recientes, enteramente las mismas especies como hoy día se encuentran en la orilla del Océano Pacífico. Estos depósitos los hemos encontrado en todas partes del referido distrito; en algunos lugares estos restos de conchas marinas son escasos, pero siempre se encuentran por lo menos algunos fragmentos. Los hemos observado desde la orilla del mar continuamente hasta el punto más alto 1050m., visitado por nosotros, y allí nos dijo nuestro guía que las mismas conchas se hallaron en perfecto estado y en grandes cantidades también en las sierras a nuestro lado, sierras que probablemente pasan la altura de 1800m. Hemos visto que estas conchas no se encuentran únicamente en el lado del Pacífico, sino hemos podido seguir a estos depósitos atravesando la sierra para el lado del Golfo de California y el punto más alto alcanzado por nosotros es precisamente el puerto de San Juan en el parte-aguas de la sierra de San Borjas. No sabemos con exactitud hasta qué altura llegan estos depósitos enteramente modernos en la región al Norte de San Quintín, pues para esto sería necesario un estudio de aquellas regiones en este sentido. Nosotros hemos visto allí estos depósitos hasta la altura de unos 200m.; cerca de la ex-misión de San Miguel se encuentran estos depósitos de conchas recientes según las observaciones del Sr. Francisco Crosswhaitte en una altura de 300m. El Sr. Crewe Read, viajero explorador inglés, nos comunicó que había observado grandes cantidades de conchas recientes en un rincón del valle de la Ensenada en la cresta de la sierra de San Pedro Mártir, en una altura de más de 2000m. Los Sres. Alfredo y Andrés Johnson que son probablemente los mejores conocedores de la sierra de San Pedro Mártir y del desierto que queda al Este de ella, nos han dado algunas informaciones interesantes. Entre otras cosas, nos dijeron que en el Cajón, un portezuelo en la región de Aguascalientes situado en la vertiente del golfo de la Sierra de San Pedro Mártir se encuentran en una altura de 3,000 a 3,500 pies (aproximadamente 1,000m). numerosas conchas marinas recientes pertenecientes a las mismas especies que hoy día se encuentran en la playa del mar. Según las indicaciones de los Sres. Johnson, las conchas más frecuentes en aquella localidad pertenecierán a los géneros Mytilus, Venus y Pecten. Los referidos señores no recuerdan haber visto conchas recientes a mayor altura en la sierra de San Pedro Mártir. La existencia de conchas recientes a gran altura en la vertiente oriental, hace ser probable que antes también existían en la lado del Pacífico de al sierra de S. Pedro Mártir, pero debemos tomar en consideración que en esta región las lluvias ya son mucho más frecuentes y más abundantes, la vegetación es mucho más densa, de modo que la mayor parte de las conchas recientes ya deben de haber sido destruidas y es probable que sólo en algunos lugares muy favorables se habrán conservado algunos restos.

Este hallazgo de conchas recientes en todas partes y en alturas muy grandes, nos prueba que la Península debe haber sido cubierta por el mar en tiempos muy recientes, probablemente todavía en aquel período que en Europa se designa como el período prehistórico. En aquel tiempo estaba casi toda la Península sumergida y probablemente sólo los picos más altos de la sierra de San Pedro Mártir salían fuera del agua. Que esta sumersión de la Península ha tenido lugar en tiempos geológicamente no muy remotos, lo prueba también la forma de los valles y cañadas producidos por la erosión del mar los que conservan todavía en muchas partes su forma primitiva casi sin alteración, de modo que la erosión no ha tenido tiempo para darles a las corrientes de agua una dirección determinada y que éstas no hayan formado valles de erosión de ríos. No podemos entrar en la discusión detallada de este problema tan importante para la geología por no ser este informe el lugar propio para esto, sino que lo haremos en nuestro informe geológico. Hay mucha probabilidad que esta sumersión de la Península no tocaba únicamente a la parte septentrional sino también a la meridional, lo que indican las observaciones hechas allí por el Dr. E. Wittich

Hemos discutido aquí estas observaciones nuestras de una manera algo detenida, no porque se trata de un hecho sumamente importante para la historia geológica del país y que quizá tendrá su significación también para otros países, sino porque tiene también su interés práctico. Después de estar durante cierto tiempo debajo del nivel del mar la Península, ha emergido de él de una manera bastante rápida y probablemente con un movimiento escalonado, como lo indica la existencia de terrazas de altura y extensión determinada, así como la abrasión en escalones. Este movimiento de emersión, del cual no se puede todavía decir si obedece a un levantamiento de la tierra o a un hundimiento del fondo del mar, continúa todavía en la actualidad. Una idea de lo rápido de este movimiento, nos podría dar, hasta cierto grado, lo que dice Clavijero sobre él. En su obra encontramos la siguiente frase: "Los misioneros jesuitas de Loreto, observaron que las aguas en menos de cuarenta años, se habían retirado muchos pasos de aquella costa....." Se ve de esto que el movimiento es bastante rápido; podemos citar otra prueba para la emersión paulatina de la Baja California. Se sabe que en tiempos anteriores, hasta la mitad del siglo pasado, la bahía de San Quintín fué frecuentada por piratas y balleneros; éstos que dieron a la citada bahía el nombre de Five Hill Bay, entraron en ella con sus buques, lo que hoy día ya no sería posible; la profundidad de la bahía debe, pues, haber disminuido bastante desde hace 60 años. Esto se confirma por la existencia de un banco de ostiones sin ejemplares vivos frente a la población de San Quintín que actualmente sólo durante la marea alta está cubierto por el agua; delante de este banco se encuentra otro a un nivel aproximadamente de un metro más abajo, que se compone de animales vivos. Esto indica que el banco superior que es enteramente fresco, ha muerto a causa de la bajada del nivel del agua y que entonces se ha formado uno nuevo adelante del primero.

Estos movimientos se pueden medir sólo por medio de un mareógrafo registrador cuyo establecimiento en varias partes de la Península sería de suma utilidad aunque sería necesaria una serie de observaciones durante muchos años para que puedan sacarse conclusiones de valor. Pues la consecuencia de este movimiento de emersión es que las bahías y puertos de la Península se harán paulatinamente menos hondos, lo que se tendrá que considerar a la construcción de puertos artificialcs y muelles. Si este movimiento continúa, las barras delante de las lagunas, ofrecerán año por año mayor obstáculo para la navegación, pues bahías que hoy parecen ofrecer buenos fondeaderos serán quizá ya en 50 años muy poco profundas o necesitarán un trabajo constante de dragado.

La República del Salvador, S. A.

La República de El Salvador es una de las cinco naciones que constituyen la agrupación Centro-Americana que sin ser la más grande ni la más populosa de ellas, puede considerársela como que ocupa puesto muy importante entre sus hermanas. En estos tiempos en que tan de priesa se hace la historia sobrevienen cambios transcendentales en unos pocos años, cambios que antes implicarían larguísimo período para su dasarrollo. El Salvador se ha visto frecuentemente envuelto en el pasado ya en guerras con sus vecinos, que apenas pudieran llamarse con justicia de carácter internacional, dadas las numerosas condiciones de identidad que existen entre todas las naciones Centroamericanas y que hacen de ellas una sola entidad étnica y social de hecho, cualesquiera que sean las divisiones y separaciones que establezcan los sistemas políticos vigentes.

El cambio transcendental a que queremos referirnos radica en el establecimiento del crédito de la República de El Salvador en el extranjero, dentro de un plazo tan corto como el transcurrido desde la última guerra que conmovió al país. La República siempre ha cumplido sus compromisos en el extranjero, pero es claro que el crédito de un país empeñado en guerra tiene que sufrir notable quebranto; de ahí el que hablemos del restablecimiento del crédito.

El crédito en el extranjero refleja la impresión que un público imparcial se forma respecto de las aptitudes que el país, a quien el crédito se otorga, posea para el desarrollo de su riqueza y para su buen gobierno. Pudiera decirse que esta regla no es del todo exacta, puesto que en tiempos anteriores los países capitalistas han otorgado crédito a otros que, al poco tiempo han fracasado lastimosamente. Esto es cierto; pero precisamente la experiencia adquirida es la que hace que hoy el crédito de un país en el extranjero haya venido a constituir, con mucha mayor eficacia que antes, un exponente, si no infalible, por lo menos muy digno de respeto, respecto a sus capacidades para su propio gobierno y para la acertada administración de su cosa pública, que en definitiva es lo que constituye el verdadero "desideratum" de la organización política de un país.

La República de El Salvador colocó en el mercado de Londres no ha mucho tiempo un empréstito de un millón de libras esterlinas. Esto significa que en el centro monetario y capitalista del mundo se tiene confianza en la habilidad y en la honradez de la Administración pública de El Salvador, y se juzga que el país ha entrado resuelta y decididamente por la vía del progreso y de la paz.

La actual Administración salvadoreña, resolvió buscar en el mercado europeo una suma suficiente para cancelar todos aquellos empréstitos locales existentes, obteniéndola a menor interés, en condiciones de pago menos gravoso y asegurándose completa facilidad para la administración de las rentas públicas. Hubo en esta decisión un alto grado de sagacidad que, secundado por una pericia serena, ha culminado en el triunfo obtenido, doblemente valioso, ya por los resultados inmediatos, ya porque establece el crédito nacional en el mercado mundial, y de esta suerte contribuye a aumentar las facilidades del Gobierno y del público para la consecución de los capitales que más adelante puedan necesitarse para la explotación de las riquezas naturales del país.

Del prospecto publicado en Londres por los agentes del Gobierno salvadoreño, son especialmente dignos de mención los siguientes datos, que no requieren comentario adicional ninguno.

El empréstito está directamente garantizado por la República, con garantía específica sobre los derechos arancelarios de $3.60 pesos oro americano sobre cada 100 kilogramos de todas las mercancías que se importen a la República y sobre un impuesto de exportación a razón de 40 centavos oro americano sobre cada quintal de café, hasta completar los primeros 500.000 quintales que en cada año exporta la República.

En los tres años de 1904, 1905 y 1906, el término medio de la exportación de café fué de 660,000 quintales, y el rendimiento medio del impuesto de exportación fué $264,000 pesos oro. El término medio de los derechos arancelarios arriba mencionados, en los tres años dichos, fué de $523,200 pesos oro.

La suma requerida para el servicio de interés y amortización del empréstito que acaba de contratarse, es de 85,000 libras esterlinas anuales, y el monto total de las rentas destinadas a ese servicio excede de $140,000, libras al año. Como se ve, pues, la garantía no puede ser ni más clara ni más segura.

La República de El Salvador no tiene deuda externa ninguna, fuera de esta que acaba de contratar. La deuda interna era de 18½ millones de pesos plata en 1899. Durante las últimas Administraciones, ha sido reducida a 3½ millones de pesos plata, incluyendo capital e intereses.

Del desarrollo de la República en los últimos veinte años, puede juzgarse por estas cifras. En 1887, la renta total de Aduanas ascendía a $1.795.378,53 pesos. La siguiente tabla indica el movimiento respectivo en los últimos seis años:

Años	Aduanas — Pesos plata	Licores — Pesos plata	Otras rentas. — Pesos plata	Total
1902..	4.272.417,07	1.857.706,42	571.898,21	6.702.021,70
1903..	4.273.133,92	1.645.706,19	573.205,58	6.792.045,69
1904..	5.124.085,11	2.143.369,66	793.234,28	8.060.689,05
1905..	5.567.448,17	1.924.911,07	1.044.083,83	8.536.443,07
1906..	5.431.169,18	1.994.266,46	1.058.984,14	8.484.419,78
1907..	5.551.900.00	2.350.000,00	832.250,00	8.734.150,00

El valor de las importaciones y de las exportaciones durante el último quinquenio fué:

	Importaciones	Exportaciones
1902 .. .. pesos plata	6.181.616,43	10.278.151,98
1903 .. .. „	6.949.073,47	14.173.863,11
1904 .. .. „	8.123.348,18	16.588.611,77
1905 .. .. „	9.778.658,22	14.098.833,15
1906 .. .. „	9.368.299,35	16.308.554,32

Las cifras precedentes demuestran que el valor de las exportaciones de la República excede en mucho al de las importaciones. Los principales artículos de exportación son café, añil, bálsamo, azúcar, tabaco y oro y plata de las minas explotadas en el país. El término medio de la exportación de estos metales en los años mencionados fué de.... $1.800,000 pesos al año.

La densidad de la población es de 139 habitantes por milla cuadrada, que es, con mucho, superior a la de la de la mayor parte de las Repúblicas latinas de América.

En los últimos años se han realizado mejoras públicas de la mayor importancia habiendo aún varias en vía de ejecución bajo la presente Administración.

El sistema ferroviario del país cuenta ya, desde hace algunos años, con la muy importante línea que pone en comunicación a las dos principales ciudades de la República, que son la Capital, San Salvador y la ciudad de Santa Ana, situado en el centro de la región cafetera y ambas con el puerto de Acajutla en el Pacífico.

Como es bien sabido, en la conferencia recientemente celebrada en Washington, los delegados de las cinco Repúblicas Centroamericanas firmaron varios tratados que, sin duda, contribuirán mucho a consolidar la paz dentro de las Repúblicas mismas, así como entre unas y otras.

Hemos querido suministrar datos pormenorizados sobre el empréstito salvadoreño, porque éste es un acontecimiento histórico de la mayor importancia. La era moderna finca sus más altos triunfos en lo económico y en lo industrial. Cuando la miseria y la pobreza imperan, la paz es precaria y las instituciones, por libres y justas que sean, funcionan con dificultad. Al amparo de la prosperidad material se asegura el progreso moral e intelectual, y de esta suerte las naciones como El Salvador y los demás pueblos congéneres, pueden llegar a justificar su derecho a la estimación y aprecio de las demás naciones del mundo.

Sobre la América latina, en general, pesó, durante la mayor parte del siglo XIX el cargo, de que era ella incapaz para su propio Gobierno y la amenaza de que, siguiendo el atormentado curso de las revoluciones internas, habría de llegar el día en que, bien los Estados Unidos de Norte América, o las naciones más poderosas de Europa, habrían de intervenir para el restablecimiento del orden y de la paz pública eliminando de hecho la soberanía de pueblos que no habían podido comprobar que eran dignos de ejercitarla. Esos tenebrosos vaticinios no caben ya respecto de aquellos países, pues si bien es cierto que del fermento revolucionario quedan todavía gérmenes y vestigios en muchas partes, como no podía menos de suceder después del largo período de inestabilidad y de revueltas, también lo es que cada día se establece con mayor fuerza y con mayores elementos de éxito, una orientación hacia la vida normal y hacia la verdadera libertad basada en la justicia.

La operación rentística realizada por la Administración y por sus hábiles colaboradores en Londres, reviste, pues, un alto significado, es un signo de los tiempos y un presagio de las posibilidades que se anuncian. La redención material en lo económico y en lo fiscal, no será menos gloriosa ni menos meritoria que la adquisición de la soberanía nacional.

El criterio de los hombres empieza a comprender que pesa más en la historia de los pueblos un gobernante que aumenta su bienestar y que crea nuevos elementos de riqueza pública, que un conquistador, o un vencedor en empeños guerreros, estériles las más de las veces, y necesariamente crueles.

Es este modo de ver las cosas el que permite apreciar, en toda su importancia, una operación como la descrita en los párrafos precedentes, que suministrará a una nación animosa y robusta, como lo es El Salvador, los elementos indispensables para las luchas de la paz, cuyos fecundos triunfos caen sobre las generaciones como una bendición y fructifican, más allá de las propias fronteras, con toda la prodigiosa fecundidad del buen ejemplo.

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*La Calidad de los Carbones de Hulla para Combustible.**

Es de suma importancia conocer la calidad de los combustibles, pues de ello depende el rendimiento de calórico y el mantenimiento en buen estado de los generadores de vapor; de modo que existe especial interés en asegurarse el consumo de un producto de buena calidad y de rendimiento calorífico elevado, todo lo cual se consigue fácilmente estableciendo bases de recepción lógicas y equitativas.

Desde hace años se ha generalizado el sistema de la compra de combustible por contrato, especificando las bases de su calidad, pero no obstante las objeciones que a ésta forma de adquisición han opuesto los vendedores, se ha generalizado siempre, hasta que hoy un consumidor de importancia impone como condiciones de aceptación el análisis y los ensayos del combustible antes de recibirlo. Es evidente que los adquirentes impongan en sus contratos cláusulas tales que aseguren la entrega de un producto de buena calidad y de máximo rendimiento y que no basta que el carbón deba ser de una mina determinada, pues aparte de la injustificada preferencia que de ese modo se diera, no aseguraría de ninguna manera un producto uniforme, aunque procediera de una misma mina y de la misma región y aún de vetas iguales, las propiedades efectivas de un combustible pueden variar notablemente.

Establecidas las características, no debe a nuestro juicio desecharse un cargamento por no ajustarse estrictamente a ellas, porque es menester tener en cuenta que siendo el carbón un producto natural no sería lógico rechazarlo por aquellas causas, siempre que la tolerancia no afecte al buen mantenimiento de las maquinarias y que sea compensada su deficiencia por una reducción en el precio; pues no sería equitativo asignar el mismo valor por un combustible cuyo rendimiento fuera inferior al especificado previamente.

Estando el carbón sujeto a aumento de peso por acción de las variaciones atmosféricas, es evidente que el límite de tolerancia de la humedad deba establecerse para la rectificación del peso de combustible recibido.

Respecto de las materias volátiles cuya producción está directamente ligada con el rendimiento, se debe tener en cuenta el uso a que se destina el combustible y especialmente la característica del hogar: existen hogares que del punto de vista del rendimiento, admiten carbones con mayor proporción de materias volátiles que otros; pero en términos generales su contenido no debe pasar de 20 por ciento. Generalmente una proporción mayor implica pérdida considerable de productos combustibles no quemados. Por otra parte los carbones que tienen exceso de materias volátiles se funden en el hogar y obstruyen el peso del aire, haciendo la combustión incompleta, produciendo considerable cantidad de humo y ocasionando obstrucciones en las cañerías.

Los carbones contienen mayor o menor proporción de materias minerales inertes desde el punto de vista del rendimiento de calórico y en algunos casos son perjudiciales para los órganos de los generadores de vapor. Es prudente establecer un límite máximo de tolerancia del rendimiento y uno máximo de aceptación del punto de vista del mantenimiento de los órganos generadores, pero el límite máximo de tolerancia de aceptación deberá establecerse de acuerdo con principios económicos y de conservación. En efecto: un combustible con mayor cantidad de cenizas cuesta por flete más que uno con menor proporción, pues este se reparte proporcionalmente a la cantidad del combustible y no a la de materia combustible propiamente dicha capaz de quemar, además impide la entrada fácil del aire y por consiguiente hace más difícil la combustión y por otra parte, se necesita mayor personal para el cuidado de los hogares. Por todas estas consideraciones es equitativo recargar con un descuento mayor del proporcional todo porcentaje más elevado del límite admitido.

Como una de las causas del deterioro de las parrillas es debida a la fusibilidad de las cenizas, la cual es función de su composición química, se debe tener en cuenta, siempre que el porcentaje de aquellas sea mayor que el indicado, imponer un límite en su fusibilidad.

La mayor o menor proporción de azufre del carbón, ya sea del contenido en la molécula orgánica, o al estado de

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De Ingeniería de Buenos Aires, República Argentina, S. A.

sulfuro o sulfato, produce en algunos casos corrosiones de mucha importancia en las calderas y demás órganos, por cuyo motivo se debe fijar un límite máximo de tolerancia de ese elemento.

Desde el punto de vista del rendimiento, el dato de mayor importancia está dado por el poder calorífico del combustible, especificándose la cantidad límite por efecto del pago y la mínima tolerada para la aceptación del producto. Y esto es lógico porque recibiendo carbón de pequeño poder calorífico los gastos por carga, descarga, mantenimiento del hogar, etc., aumentan.

Como el polvo fino no sólo produce mermas más o menos apreciables en las manipulaciones del carbón, sino que pasa al través de las parrillas y no se quema, se debe establecer en las condiciones de aceptación un límite máximo de admisión.

Las características del carbón para hogar no deberán variar fundamentalmente y estarán comprendidas dentro de los límites siguientes:

Humedad, máximo 20 por ciento.

Cenizas, máximo 5 por ciento.

Materias volátiles, máximo 20 por ciento.

Poder calorífico, mínimo 8.000 calorías.

Poder evaporante práctico, mínimo 10 litros por kilogramo de carbón.

Azufre total, máximo 1 por ciento.

Polvo fino, máximo 7 por ciento.

Para efectuar los análisis químicos, dada la heterogeneidad del producto, será necesario extraer las muestras de tal manera que representen el término medio de la partida, para lo cual aquéllas se obtendrán tomando proporcionalmente trozos grandes y carbón fino hasta completar una cantidad de 500 kg. por lo menos y teniendo la precaución de que dichas muestras correspondan al conjunto del cargamento y no a una porción de él. La parte gruesa será rota hasta obtener trozos de una dimensión que no pase de cinco centímetros y el carbón fino se mezclará completamente con aquellas esparciéndose el conjunto sobre una plataforma cuadrada de cemento o fundición. El cuadro de carbón que así resulta se dividirá por sus diagonales y se retirarán dos cuartos opuestos por el vértice, las partes restantes se extenderán nuevamente en cuatro y así sucesivamente hasta obtener un peso de cerca de diez kilos.

Los análisis deben efectuarse de acuerdo con un sistema previamente detallado a fin de evitar dificultades y discusiones inherentes al distinto método empleado en el enseye. De una manera muy somera en el pliego que transcribo están expuestos los métodos admitidos.

Las tolerancias, causa de rechazo y correcciones en el precio, están suficientemente explicadas en el mismo pliego, y sus razones se exponen en el curso de esta nota.

La Dirección de las Obras Sanitarias de Buenos Aires, Argentina, C. A., encargada de la compra de combustible para diversas reparticiones de la nación, ha establecido últimamente las condiciones para la aceptación del combustible cuyas partes pertinentes van a continuación:

Artículo 1°.—**Calidad del carbón.**—El carbón deberá ser de primera clase, tres veces zarandeado, y de calidad igual a la del mejor carbón de los conocidos con el nombre de Cardiff.

El carbón provendrá de cualquier región y de cualquier mina, debiendo establecerse claramente en la propuesta de qué región y mina procede el carbón que se ofrece. Cuando se proponga entregar de dos o más minas, se indicará la cantidad que se entregará de cada procedencia. Cada cargamento será de una sola mina, no admitiéndose cargamentos mixtos.

Las características del carbón que se entregue no deberán variar fundamentalmente, y estarán comprendidas dentro de los límites siguientes:

Humedad, máximo 2 por ciento.

Cenizas, máximo 5 por ciento.

Materias volátiles, máximo 20 por ciento.

Poder calorífico, mínimo 8.000 calorías.

Poder evaporante práctico, mínimo 10 litros por kilo.

Azufre total, máximo 1 por ciento.

Polvo, máximo 7 por ciento.

Artículo 5°.—**Extracción de muestras.**—Para efectuar los análisis y ensayos se extraerán las muestras de carbón en el momento de la entrega en los puertos de Buenos Aires, Rosario, Santa Fé y Paraná, debiendo efectuarse un análisis y ensayo por cada cargamento completo.

La muestra se obtendrá tomando proporcionalmente trozos grandes y carbón fino, hasta completar una cantidad de (500) quinientos kilogramos por lo menos, teniendo la precaución de que dicha muestra corresponda al conjunto del cargamento y no a cierta parte del mismo.

La parte gruesa de la muestra será rota hasta obtener trozos cuya mayor dimensión no pase de (0,05 m.) cinco centímetros, y el carbón fino se mezclará completamente con los trozos, esparciéndose el conjunto sobre una plataforma cuadrada de cemento o fundición. El cuadro de carbón que así resulte se dividirá por sus diagonales y se retirarán dos cuartos opuestos por el vértice; las partes restantes, bien mezcladas, se dividirán nuevamente en cuartos como antes, y así sucesivamente hasta obtener un conjunto que pese alrededor de (10) diez kilógramos. Este conjunto se envasará por partes iguales en tres tarros de vidrio, uno de los cuales se enviará al laboratorio de ensayos de la administración para efectuar el análisis químico correspondiente.

[Continuará.]

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THE MEXICAN MINING JOURNAL

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Mexico's Wonderful Vitality.

Although condition have been so unfavorable, during the past few years, at least in southern Mexico, that, "Mining! There ain't no such thing!" has been a favorite expression among mining men in the capital city, yet the mineral production of the country continues to be an importan factor in the world markets. The recent drop of nearly three cents in the New York quotations for silver are said to be directly due to a huge shipment of accumulated bullion from Pachuca. Of course Pachuca is an exceptional camp even for Mexico, and the conditions which made it possible for the mines to continue operations there almost without interruptions were also exceptional. Nevertheless this isolated and exceptional circumstance gives one a sense of the importance of the country and its mines in the mineral industry of the world. If the mines of Mexico can still disturb the markets of the world after years of turmoil, stagnation and decadence, what can they not do when conditions favorable to enterprise and expansion once more return to the country?

Another note found hidden among the rare cable despatches which we are still permitted to see, bears witness to the latent vitality of the country. It seems that in spite of five years of upheaval preceded by an equal period of apprehension, Mexican bonds are still quoted in foreign markets at a higher rate than those of certain countries in South American and Europe which enjoy a settled and apparently stable from of government.

Evidently there is still plenty of confidence in the future of Mexico, and it is not likely that those of us who have waited courageously for the country to recover from its political indigestion and for the return of prosperity will in the end be disappointed.

The Butchart Riffle System.

For months we had been hearing wonderful tales about the wonderful work done in the Southwest on Wilfley tables fitted with a modified riffle embodying the results of local experience and ingenuity. For months there was no mail service, and the mining men and metallurgists marooned in the city could only wonder and speculate as to what men of their profession were doing in the outside world in the way of progress and as to how far their own ideas would be out of date by the time they should again be permitted to take part in the ever interesting game. We heard of mills remodeled, eliminating scores of concentrating machines, of Wilfley doing the work of six similar tables under the old arrangements, of tonnages up to 200 tons per diem handled by a single unit, and all these marvels rendered possible by a simple modification of arrangement in the ordinary Wilfley riffle. Now a belated mail brings a description of the Butchart riffle and the converted Wilfley known as the

National table, and in the present issue we present some details of the work done as well as a diagram of the modified arrangement.

The introduction of the Wilfley oscillating table in 1897 brought a new element into the concentrating mill, something quite distinct from the standard jigs, vanners and plane tables. Its simplicity of construction and operation and its moderate expense for power and repairs immediately won for it a place in ore dressing plants everywhere. That its success was deserved is shown by the excellent work done by Wilfley tables during the years that followed and the many imitations which have appeared in the market.

This family of straight-riffled, oscilating tables, which has of late years grown very large, all give excellent conditions for the stratification of the mineral particles, but in segregating the different strata and in washing the product they have not equalled some of the other types of concentration machines. In treating material with a high ratio of concentration has this inability been especially noticeable, and for handling the coarse feed of the jigs the table as originally arranged could not be used at all. As a universal concentration machine, suitable for all classes of material and all classes of work for gravity separation the Wilfley, therefor, fell short of the claims at first made for it. It gradually settled down to the work of an intermediate concentrator in which capacity it has for years done excellent service and at a low cost. From time to time attempts have been made to convert the oscillating, riffled table into a roughing machine by the use of high riffles and an extreme inclination of the working plane, but with varying success. It was not until the curved riffle made its appearance that the full possibilities of the oscillating table began to appear.

Of the astonishing things accomplished by tables fitted with the curved Butchart riffles some are described in an article on another page of the present issue. In one mill the mere substitution of the curved for the straight riffle resulted in the elimination of eighty-four standard machines of various types and uses. Just why a simple curve in the riffle should so profundly affect the results has as yet not been fully explained. The slight departure from the longitudinal, parallel to the motion of the table, seems to impart a sort of vanning stroke to the particles already stratified during their passage through the straight part of the channel. At any rate the segregating and washing functions of the table are greatly improved and the capacity both as to tonnage and ability to adapt itself to varying conditions and load is greatly increased.

The introduction of the Butchart riffle has already modified metallurgical practice in the great concentration camps in southwestern United States. The tendency there as elsewhere is from the complex to the more simple. In one mill, also described in the present issue, practically all of the work is done by a crushing plant of the simplest type followed by a set of modified Wilfleys and a battery of flotation machines. There are those who predict that this will be the standard mill of the future, embodying as it does the three basic operation, crushing, separation by gravity and separation by flotation, all reduced to the simplest possible means and combinations.

Efficiency Systems.

The death of Frederick W. Taylor, the orignator of the Taylor system of efficiency engineering, while still a comparatively young man, calls attention to the fact that the life of a productive unit may be quite as important as its efficiency during any single period. Mr. Taylor spent a considerable portion of his life in reducing, or increasing, men to a machine-like standard of efficiency, and to getting every possible stroke of work out of the machine units in a shop. His system took due precautions against everloading any machine or unit. No doubt he applied his own system to his personal activities yet we see him disappear from the field before he had fairly passed his prime.

The Taylor system was first developed and applied to machine shops where the bulk of the work was of routine and similar character, but it was later extended to other lines of work, in many cases where the conditions were too complicated to be completely regulated and controlled. The system has revolutionized shop practice in many ways, and it should not be blamed for failures when applied outside its proper field. The origin of the Taylor system lay in the desire to equalize the work of the lathes, planers and other units in a shop doing the same class of work. It was noticed that a certain lathe operated by a competent workman would turn up, say, ten per cent more car wheels than another similar lathe doing the same class of work. The difference was not due to the negligence of the men, but to differences in mounting the work, the selection of cutting tools, the speed of drive, depth and width of cut, etc., etc. Under the improved system, all these matters, hitherto left to the discretion of the workman, were determined beforehand by engineers employed for that purpose. The piece of work came to the lathe bearing a card indicating not only the kind of cutting tool to be used, the speed and depth of cut, but even the time to be consumed in mounting the work and taking it down after completion.

Of course the system was not popular with the skilled workmen who had gained their skill by years of practical experience. They prided themselves upon their practical knowledge of just those details which the system proposed to take out of their hands. It reduced the men irrespective of their years of experience and length of service to the level of a machine, permitting them to make only a prearranged series of actions, reducing lost motion to a minimum. There was plenty of friction, especially with the older men, but in time with a newly selected force of men, the system was firmly installed, with a remarkable increase of efficiency and uniformity of work done.

Since then the system or a modification of it has been tried in every conceivable line of work where numbers of men are employed, from quarrying rock to accounting in large city offices. It was soon found to have its limitations, for where conditions varied

greatly, the expense for engineers to lay out the work became greater than the increased profit secured by reason of more efficient work in the shop. Still it had its beneficial effect, for it called attention to the prevalence of lost motion which is the great enemy of efficiency in the human machine everywhere.

No great success has ever attended attempts to apply efficiency systems to mining. The difficulties are obvious. There is not sufficient uniformity in the work to be done. Yet here too the influence has been felt. We have more definite standards of time of drilling and other operations than we had twenty years ago. To make every move of a miner effective by rule in this country will always be impossible. A good way is the contract system, introduced with so much success in some parts of the country, paying according to the work done, and leaving it to the individual worker to develop his own efficiency system.

The Freiburg "Jahrbuch" for 1914.

The annual "Jahrbuch für das Berg-und Hüttenwesen" in the Kingdom of Saxony for the year 1914 has just been received. The volume is published at Freiburg and contains much information concerning the great mining school where so many of the pioneer mining men of Mexico and the United states received their technical instruction. This great institution still attracts students from all parts of the globe. In 1914 there were students enrolled from nearly ever latin-American country except Mexico and from every country of Asia and Europe. The curriculum of the studies of the students in mining are given in full, and the subjects are quite decidedly up to date as is to be expected. There is even a course in the study of radium. The professor in charge of this branch has, by the way, fallen in battle in northern France since the issue of this volume, the fact being recorded by means of an insert attached to the title page. Other members of the faculty have also been either killed or wounded while fighting with the armies of Germany.

The wonder is that in Freiburg where the art of mining has been so highly developed there should be so little mining. The tonnage output of the mines look puny beside those even of a minor camp in Mexico. Although the out-put of individual minerals, except coal and lignite, is small the number of minerals exploited is large, including a considerable proportion of those of the rare elements only recently rendered useful in the arts. A considerable part of the volume is devoted to reports of sick and benefit funds and their administration, a work which has attained a wide development throughout Germany.

"Metal Statistics," 1915.

The eighth annual edition of this volume, published under the auspices of the "American Metal Market and Daily Iron and Steel Report," is somewhat larger than the preceding editions, for it contains besides the usual statistics of production and prices of metals, the figures relating to the production of coal, petroleum and cement as well.

The statistics are derived from various sources, from reports of the U. S. Geological Survey, of the New York Metal Exchange, Henry R. Merton & Co., Metallgesellschaft, the Iron & Steel Institute, and the daily reports of the American Metal Market and Daily Iron ad Steel Report. Of peculiar interest are tables showng the variations of metal prices over a term of years. For instance we find that the price of silver has recently been the lowest in the history of mining for that metal. The highest price recorded for the past twelve years was in November, 1906 when it reached an average for the month of 70.8 cents.

Brick as a By-Product from Metallurgical Plants.

The Anaconda company is adding another to the many sidelines of its great metallurgical plant. Not content with furnishing almost enough copper to keep the European armies supplied with ammunition, and immense quantities of arsenic, sulphuric acid and other secondary products, it is now preparing to make brick from the tailings of its flotation plant. Machinery has been ordered having a capacity of 50,000 brick per day. The composition of the tailing is such that the brick can be used as fire-brick.

The brick exhibited at the recent meeting of the A. I. M. E. in New York is very fine-grained, for the tailings from which they are made is mostly ground to 200-mesh, the discharge from the slime tailings flotation plant. From 2000 to 2500 tons of this material will be discharged daily but only one-tenth of the total amount will be required by the brick-making machinery thus far ordered. There will, therefor, be abundant room for expansion if the demand from the surrounding territory should increase.

Colonel Tepetate.

"I see they've started another get-together movement in the States," remarked the Pessimist.

"Who is getting together this time?" demanded the Colonel.

"As near as I can make out, some of the big employers have an idea that graduates from the engineering schools would make good bosses for their mines and mills. So they are steering the college boys up against some of the real laboring class in the Y. M. C. A."

"What's the idea? "inquired the old man sceptically. "Do they go at it with boxing gloves?"

"I haven't made out exactly how they are going to work it. The idea seems to be to get the future bosses to understand the men better and to be more in simpathy with them."

"Is it sympathy that they want? Why. I've fired more bosses for having too much sympathy than for hitting the booze trail. I suppose you'll be starting a Y. M. C. A. for your peons when you can get back to work."

"I hadn't thought of any such thing," replied the Pessimist indignantly. "You seem to think I fall for every crazy notion that comes out of New York."

"I didn't say anything about crazy notions. It struck me funny to think of your Bill Pastem consort-

ing with a bunch of peons, trying to understand them and to get into sympathy with 'em. I was just thinking that you couldnt very well hold a meeting of that kind in the almacen, and I was wondering whether you'd furnish chairs for them all, and what old Bill would say to his flock."

"Oh! Well. You can make anything ridiculous if you want to."

"The idea is not so ridiculous. It's the practical application, right here and now that looks queer. It stands to reason that if a boss does not understand his men he can't be much good; and by the same token, if the men spend all their time figuring how to get even with the boss, the work in going to suffer."

"I don't see much in it."

"It all depends upon what you mean and what whoever started this thing means. If they mean to train bosses by any such a scheme as that—bosses, good bosses, aren't made; they're born. If they mean to reduce the cost per ton by means of the brotherly up-lift business—that all depends upon the kind of men you've got to deal with. If you're talking about five-dollar-a-day skilled mechanics, a tract may persuade them to do more work for a dollar if the union leaders don't object. If you are talking about muckers and shovel men in general, the main thing is that the boss must be boss, and no question about that."

"You mean the pick-handle method?"

"Not necessarily that. I wouldn't have a boss who couldn't stay boss without that. The brutal boss is never a good one. Other things being equal the soft-spoken chap gets more work done and with less friction. But I can see the point of the section boss who said that he wouldn't have anybody on his gang whom he couldn't lick, and stood ready to try it out. It would be fine if we could all employ educated labor, men with a keen sense of duty to their employers, men who understand the laws of economics and who care more for standards of ethics than for beer. But raw labor, labor that needs a boss, isn't like that in the United States no more than in Mexico."

"Polacks and Hunkies and Chinks and peons have got to have a boss that they're afraid of," remarked the Pessimist quite convinced.

"There you go again, "returned the old gentleman disgustedly." You make the same mistake that the bosses of the bosses are making all of the time. Fear is mighty poor incentive for getting the best out of a man. Perhaps that is the only thing that will touch a mule, but even a dog will do more under some other incentive. The only essential is that the boss's will must be supreme. It doesn't matter so much how he gets that supremacy. The main thing is that he's got to have it. To get it by the weight of his fist seems to me the poorest way, but if he can't get it any other way, that's what he's got to do. I'd rather see him get that supremacy and keep it by a superior intelligence, by knowing the job better than anybody else, by taking advantage of every individual worker's kinks of character, and by being exactly fair and square. A boss ought to work with his head; not with his fists."

"Huh! What you want is a staff of general managers and supreme court judges."

"I wouldn't mind, that is, if they'd make good. Handling men is about the biggest man's size job on this little round world. To be the best man, actually the best man in a crowd of two or three hundred, and to have all of them admit it, not because he has the ability to fire, but because he is actually the biggest man in the bunch, that is no mean stunt. And you can't always tell by appearances."

"I've known bosses to get fired because their men liked them."

"So has everybody. And that reminds me that the men who need educating are those that hire and fire the bosses. It might do some good too, for it is a heap easier to get to understand a few bosses than to get a working knowledge of a changing gang of ignorant, lazy laborers."

"For instance!"

"Well, there was Jumping Jack Steward. He was the most misunderstood boss I ever saw. Every manager, general or common, and every superintendent who saw him in action, thought that there, now, was a fellow who could get things done. And he was usually seen in action, for he always got busy as soon as anybody took the trouble to look. He'd let out a yell like a Comanche Indian, and if everybody didn't jump and look around scared to death he'd get mad. He tried to make the men believe that he'd rather eat them than not. Then he'd look around and see some fellows trying to fix a leaky pipe, perhaps. He'd grab an eighteen inch monkey wrench and land in among them shoving them sideways with his elbows. Not that he had any idea what was the matter or what they were doing; it was merely his way of being a 'boss right on the job'."

"Nothing but a bluffer."

"He never made good, although he always got a good salary. Every manager was sorry to see him go, and couldn't understand why it was that Jumping Jack had so much hard luck."

"And the men?"

"Not a man among them would admit his superiority in anything. You see the fellow who is always getting mad or pretending to be mad is just plain ridiculous, and the sorriest peon can see it. Everybody but the managers knew him for a bluffer and they didn't seem to see through him at all. After Jumping Jack left they hired little Bob. E. He never yelled at anybody, and never seemed to get excited about anything. He always knew everything going on, for nobody was afraid to speak to him. There never was much trouble while Bob was on the job. But they fired him too."

"Why was that?"

"The manager said Bob never seemed to do anything. He was always walking around with his hands in his pockets and nobody seemed afraid of him. The manager couldn't see that it made the least difference whether Bob was around or not, and he didn't propose to pay a man for doing nothing."

The Pessimist sighed. "It's a big question," he said.

"The biggest that ever was. The poet says the proper study for man is man, or words to that effect. And that most important study is the one that is most universally neglected."

Chontalpan Mine, Guerrero.

Written for the Mexican Mining Journal
By an Occasional Contributor.

The Chontalpan mine, operated by the Cia. Chontalpan y Anexas, in northern Guerrero, is one of the unadvertised properties worked on a conservative scale in southern Mexico. The company has been able to continue work and even expand its operations through the worst years of the revolution, and to carn a handsome profit for its shareholders. Three years ago there was a five-stamp concentrating mill treating from 12 to 15 tons per day, but a large share of the revenue was derived from the sale of rich ore sorted out in the mine and on the patio. The orebodies are rather narrow and uncertain, the values occurring chiefly in chimneys at the intersections of a complicated system of small veins By a careful study of the geological conditions it has been possible to work out a definite plan of developing these bodies, with the result that the reserves have been increased and it has been possible to send a steady supply of material to the mill. The plant has been enlarged and improved, until at present it has a capacity of between 50 and 60 tons per 24 hours, and it has a thoroughly modern cyanide department for retreating the sands and slimes from the concentrating tables. The geology of the vein system and the method of development have been worked out by S. J. Lewis, consulting engineer of the company, and the mill has been remodeled under the direction of H. W. Fowler, manager in charge of the property.

Chontalpan is in the Zacualpan district, a region where the El Oro shales are common. Through these shales a number of lacolithic intrusions have been thrust, and subsequent erosion has exposed the intrusive masses in various forms. The fissures in which the mineral veins were later deposited seem not to be due to any stresses set up by the intrusions themselves, but rather to cooling stresses in the lacolithic masses. During the intrusion, masses of the shale were broken off and carried into the mass of foreign material and there remained imbedded. The vein systems frequently encounter these isolated bodies of shale, and a difference in mineralization is immediately noted when passing from the intrusive into the older rock. This is rather important in mining, for in at least one instance in the district a mine suspended operations because it had drifted into one of these isolated shale bodies, and supposed that the vein had permanently lost its value. Upon advice drifting was continued for another twenty meters, when the workings passed from the shale and re-entered the intrusive and the rich ore promptly reappeared. This same loss of values in the orebody when passing through shale masses has been observed in the Chontalpan mine. In fact the phenomenon is there well understood and allowance is made accordingly.

The present workings are developed by a main tunnel level which leads to an inclined shaft, known as the Modesto shaft, which goes down at an angle of 55 degrees. There is also a vertical shaft which has been in use only during the past year. The ore is a clean quartz, carrying silver in the form of various sulphides, a little galena, pyrites and other sulphides. The mine has shipped considerable rich ore sorted on the patio, but the bulk of the output is now treated in the plant. Costs, necessarily high when operating on a small scale and with a five-stamp mill, have been gradually reduced as the tonnage output, the reserves and the capacity of the mill increased. While three years ago it was possible to treat in the mill only ore that carried well over a kilo of silver per ton, the plant is now handling much poorer material, thus increasing the tonnage available and reducing the expense of sorting.

Vein System.

The Chontalpan mine is not on a single vein with irregular branches as was formerly supposed, but on a somewhat complex system of at least ten or twelve veins, grouped in three distinct and but little separated periods of movement, which give rise to three distinct sets of fractures. There are, first parallel veins striking nearly north and south. These all belong to the first period, and are all recognized in the mine, where they carry ore of medium grade with fair width of mineralization.

Later tension forces faulted these veins which with subsequent mineralization created what is now known as the principal vein. This has been followed on the tunnel level in the mine for over 500 meters, and with its surface working, is known for about 800 meters.

Parallel to this principal fracture and about 85 meters to the west of it, is a vein known as the foot-wall vein, having practically the same strike, N. 25 W, and the same dip, 60 degree E, that the main vein has. This foot-wall vein is narrow and has not, as yet, been explored.

At a still later period a third series of fractures was formed, which cut the principal vein series diagonally in the opposite direction. This series differs from the other series both in character of vein-filling and in grade. As a rule these cross-veins are narrow and rather rich, with abundant occurrence of silver glance and other secondary minerals. The minerals of the principal vein are also partly secondary, but chiefly zincblende, galena and arsenious and antimonial sulphides of silver. Very little oxidation is visible in the bottom levels. It is clear, therefor, that the apparent split condition of the vein is due to intersections of independent veins, and the effect of these intersections on the formation and enrichment of orebodies is important.

It is common in cases like this to find enriched orebodies close to the intersections, due to secondary deposition of silver-bearing sulphides upon those already existing. In other words, re-enrichment may come through a re-opening of old channels, allowing of further circulation of ore-bearing waters and precipitation of additional values through the reducing effect of the sulphide present. A close study of the assay sheets shows that the rich ore occurs in lenses having a recurrent relation to the intersections. Immediately at the intersections the values are low. A short distance away the values begin to increase. In some parts of the mine the difference is very marked on account of the high grade of the ore. The law of enrichment in Chontalpan is evidently that orebodies have resulted from intersections of vein systems.

Cost of Sorting and Shipping.

Above the main tunnel level of the mine is a la-

byrinth of ancient workings and stopes. Until recently these old workings had not been explored but during the past year the scarcity of dynamite has made it necessary to limit work in the solid as much possible, and the old stopes have been explored for mill material which can be extracted without blasting. Enough broken ore has been found to keep the fifteen stamps dropping for many months.

An interesting study of the cost of sorting and shipping ore was made by the consulting engineer some time ago when the question of enlarging the mill arose. In view of the fact that thousands of small properties are confronted with the same problem and that this question has received very little attention in public discussions of mining the remarks are here given in full:

"Costs have been considered high at this property. Analysis of the accounts shows that this is due entirely to the prohibitive cost of extracting shipping ore and sorting it on the patio. In studying them I find that if we take the first two weeks of May we shall have typical sets of accounts for our purpose. Everything at Chontalpan is handled weekly. For week 18 leaving out the almacen account, which comes back more or less the same, we have:

"Mining....	Extraction	$ 276.00
	Shaft Construction	283.08
	Hoisting	124.87
	Patio	73.22
	Dewatering	15.00
	Assaying	34.49
	Blacksmith	18.75
	Buscomes	615.77
		1441.40

"Out of this the shipping ores are chargeable with the following:

Shipping Ores....	Buscones	$ 615.77
	Patio	73.22
	20% of Hoisting	24.97
	50% of Assaying	17.24
	50% of Blacksmith	9.38
	80% of Extraction	138.11
		854.79

"During the week the production of these ores, having a gross value of about $402 per ton, was 6.220 tons; which divided into the cost given without adding supervision or power, makes the cost of producing high grade ore equal to $137.42 per ton.

"Now if from the total mine expense we take the item of shaft construction, $283.08, plus 60 per cent of the hoisting, due to the same, a total of $358.00, we have left $1441.40 minus 358.00, or $1083.40 and if from this we take the cost of producing high grade ore, we have $1083.40 minus $854.79 or $228.61, which remains as the cost of producting mill ore. It will be understood that the buscon system helps show low costs for mining mill ore, so that on the basis shown, the 70 tons of mill ore handled during the week cost $228.61 or $3.28 per ton. Power cost $119.73 for the week, of which half should be charged against the mine, at least. We will then have to add 86 c. per ton and the total cost of mining mill ore will be $4.14.

"Mill costs were $129.19 for the week, including all items but power. Taking one half the power, chargeable against the mill, we have $129.19 plus $59.87 or $189.06 which gives a cost per ton of $2.70.

"General expenses were:

Watchman	$ 29.00
Horses	7.00
Office	101.46
Various	22.42
	159.88 or $2.28 per ton.

"Recapitulation, we have for the mill ores:

Mining	$ 4.14
Milling	2.70
General	2.28 total $9.12 per ton.

"It is plain that the high cost of producing and sorting shipping ore is responsible for the general effect of high cost at the property. Were the vein to be stoped entire and sent direct to the mill without sorting of any description, the cost of mining would be but little higher than that computed, as it would be simply a question of so much per hole and the material for blasting. It is not conceivable that under straight stoping the cost of mining could be more than two pesos more than it is now, so that the total $9.12 could hardly go over $12.00. I believe that $14.00 per ton may be taken as an outside figure with perfect safety, or as is done below, take $12.00 as operating figure and allow $5.00 per ton for construction.

"Analysis of week, No. 19 shows similar results. Without going into details, the results are as follows; producing shipping ore, $673.53; production, 4.453 tons, each worth about $410; cost per ton (not including power), 151.25.

"If from the week's total, $1700.37 (not including almacen) we take the above cost, and also subtract the cost of shaft construction, etc., we have left $531.67 as the cost of producing 79.25 tons of mill ore, milling it, etc., or $6.74 per ton.

"It seems to me quite beyond argument that the high cost are due entirely to the production of the shipping ore; circumstances alone must determine whether this can be stopped or not. I recommend, from my point of view, that as soon as the mill is operating at the increased capacity, no high grade ore be made whatever, no matter what the temptation may be, no patio be maintained, and the whole thing be organized on the basis of stoping the vein just as it comes and sending it to the mill, cutting out every feature pertaining to sorting. This is the only way in which a small property can be run without the costs going up, and only on this basis can a manager reasonably be expected to have his cost compare with those at other mines."

The Mill.

The mill is a development of the old five stamp concentrating plant. The greater portion of the values are still recovered by concentration, the cyanide department handling the tailings from the tables. The remodeled plant has fifteen stamps and a tube mill and has a capacity of between fifty and sixty tons per 24 hours. The tailings from the concentrating tables are separated into sands and slimes and treated separately. There are five sand tanks of masonry, and six slimes tanks of the intermittent agitation and settling type commonly used in Guanajuato and elsewhere.

The concentrating department has two Wilfleys and two Johnson slime vanners replacing four Deister sand tables and two slimers of the same make.

Concentration is at the rate of about seventeen to one. Since the concentrates contain considerable lead, and communication has been very uncertain, the smelting and refining of these concentrates on the ground was at one time contemplated. However, the

ore handled is rich and the losses that may be expected in smelting rich material on a small scale is well known, and the plan was abandoned.

The plant further includes two thickeners of the ordinary type, and an Esperanza classifier. Power is obtained from the lines of the Temascaltepec power company. Early operations were hampered by a scarcity of water. This has since been remedied by the purchase of water rights in a neighboring stream, and the supply is now abundant. In spite of the increased tonnage milled, the shortage of dynamite and the fact that during the recent political upheavals much rich ore was extracted for hurried shipment, the reserves of the Chontalpan mine are better than ever before, and the enterprise, while not conspicuous for the size of the operations, must be counted among the most prosperous in Mexico.

Flotation Mill at Timber Putte, Mont.

In view of the secrecy with which everything pertaining to the flotation process is surrounded, the following extracts from a paper read before the Montana Society of Engineers by Theodore Simons, describing the process used at the Timber Butte mill for the concentration of Elm Orlu ores, is of unusual interest:

The ore contains zinc and lead as asphalerite and galena; copper as bornite, chalcocite, tennite and tetrahedrite; gold and silver free and chemically combined with the base-metal sulphides. The gangue is quartz, barite, flourite, rhodonite and rhodrocrosite. Iron occurs as pyrite. Lead occurs in small quantity only, 0.75 per cent., and consequently a large expense for its recovery is not warranted. Moreover it is intimately associated with zinc and other sulphides so that a separation is difficult. The percentage of iron is 3.29, and of zinc 18.52.

In order to make a satisfactory recovery of the lead and iron it is necessary to enrich those products at moderate cost and get something that will stand further refinement. This is accomplished by Wilfley roughing tables. These tables also recover from 25 per cent. to 30 per cent. of the total zinc in the ore at small cost. With the exception of the roughing operation, the only other gravity separation of mineral is performed on James tables that retreat the coarse part of the finished flotation product. Otherwise, all concentration is by flotation. The capacity of the mill is 450 tons of ore per 24 hours. The ratio of concentration for zinc is 3:1, and for lead-copper-iron, 125:1. Extraction averages about 96 per cent. of the zinc and 92.6 per cent. of the silver.

The striking feature in the gravity-concentration section of the mill is the operation of the Wilfley roughing tables, so-called. They are the first concentrating machines encountered in the mill, and take the undersize from impact screens without any previous classification. The tables not only handle an unusual quantity of material, amounting to more than 100 tons per table, but they make at the very outset a finished coarse-zinc concentrate, containing from 49 to 51 per cent. zinc, and not more than 4 per cent. insoluble. They also send all the fines coming from the mine nad those made in the preceding crushing operations to two Akins classifiers to be separated from the tailings, after which they go directly to the Minerals Separations flotation section, where they belong. Thus none of the intermediate machines is encumbered with this troublesome material, and the losses incident to frequent handling of slimes are reduced to a minimum. All this is accomplished by a clever modification and distribution of the riffles by giving the tables a rather steep inclination (8 deg. to 10 deg.) and by adding the proper amount of wash water.

To unlock the finest included grains of sulphides from the adhering gangue, prior to separation, it is necessary to crush the Elm Orlu ore to between 40 and 60-mesh, maximum. It was found that to attempt to extract zinc from material finer than 40-mesh by gravity concentration gave a low grade of concentrates, and would require a costly installation. This led to the adoption of flotation, according to the process of the Minerals Separation Co. The pulp is kept at a uniform density in the proportion of 3 of water to 1 of ore, and is heated to a temperature of 130 deg. F. by the introduction of live steam. From tests it appeared that with the Elm Orlu ore higher temperatures did not produce better results, while temperatures below 125 deg. reduced the efficiency of the plant.

Flotation Section.

Sulphuric acid is mixed with the pulp at the rate of 7 to 8 lb. to every ton of original ore going through the mill. Oil is added in the proportion of 0.5 of a pound per ton. Oil is introduced in the mixing compartment of the first cell where the pulp is violently churned by the action of the agitator, which at this plant makes 265 r.p.m. and causes the propeller to run at a peripheral speed of about 1500 lin. ft. per minute. The aerated mixture passes through an opening into the flotation compartment, where the froth containing the sulphides of lead, copper, zinc and iron, as well as some of the richer middlings, immediately rises to the surface while the clean gangue and the leaner middlings drop to the bottom.

The flotation compartment has the shape of a spitzkasten, the apex of which is provided with a valve, adjustable by a handwheel. Through this valve the material that has settled to the bottom of the first cell is drawn into the adjoining cell by the pumping action of its propeller. The process is here repeated, and the sulphides which did not float in the first cell are given a chance to do so in the second, and so on. By the time the pulp has reached the seventh cell of the rougher machines the clean sulphides and the richer middlings have all been floated. The remaining middlings in their passage from cell No. 7 to cell No. 11 are separated from the tailings by the successive flotation of the middlings, until in the bottom of the last cell only clean tailings remain, which are taken to a Dorr thickener for extraction of the hot water. This is pumped to a tank to be reused in the flotation machines. The middlings overflowing from the cells Nos. 7 to 11 are reground in the Hardinge mills and returned to the flotation section.

The float concentrates from the first six cells of the rougher machine is a product rich in zinc (about 47.8 per cent.) but due to the presence of middlings still contains about 14 per cent. insoluble. It is therefore sent to the first and fifth cells of a 200-ton Minerals Separation flotation unit containing eight cells. This is known as the "finisher machine," because it makes a finished sulphide concentrate. On passing the pulp through the successive cells of the finisher the sulphides are floated to the surface, while the clean middlings ultimately reach the bottoms of the fourth and eighth cells, whence they go to Hardinge mills, to be reground and returned to the flotation section.

The float concentrates from cells Nos. 1, 2, 3, 5, 6 and 7 of the finisher machines is a finished sulphide product containing, besides the sulphides of lead, copper and iron, 52 per cent. of zinc and 3.5 per cent. insoluble. The fines in this product overflow as fine zinc concentrates from an Esperanza and a Richards

classifier through which the product is passed, the coarse portion of which is retreated on James tables. On these tables the lead and iron are separated from the zinc, and the insolubles in the zinc concentrate are reduced to 3.5 per cent.

The overflow from cells Nos. 4 and 8 of the finisher machine, being apt to contain a varying amount of middlings, is returned by air lift to the same machine. The agitating compartments of the flotation cells are lined with cast iron, and the propellers are made of brass. All agitators of a standard machine are driven from one main shaft by gears, which are protected from dust by steel housings. Gears are placed so that properllers in adjoining cells revolve in opposite direction, thus equalizing the strains on the machines and power transmission.

*The Purification of Boiler Feed Water.**

It is a well-known fact that the use of bad water for boiler feed purposes is not conducive to satisfactory and economical steam plant operation. It is also true that natural waters are hardly ever pure, no matter what their sources may be, and instances are indeed rare where the water is fit to be used for making steam without its receiving treatment of some kind either before or after its introduction into the boiler. Further-more, there is a vast difference in the character of different waters, consequently each case must be studied and worked out by itself and the proper remedy prescribed. It is evident, therefore, that the elimination of impurities in the boiler-feed water and making it suitable for steaming purposes is one of the most difficult problems that confronts the engineer.

The various impurities in all waters may be divided into two general classes; namely, insoluble impurities, which can be removed by sedimentation or by filtration; and soluble impurities, which cannot be removed unless they are first thrown into suspension and then taken out by sedimentation or by filtration. While the insoluble or suspended impurities are a factor in considering the suitable of a water for boiler-feed purposes, nevertheless, they are of minor importance and can be taken out so easily that they need not here be further considered.

The most common of the soluble impurities, or those held in solution, are the following:

Magnesium sulphate, which is quite common in many waters and is extremely soluble. By itself it will not form scale, but it is easily broken up by lime salts from which scale is formed.

Calcium sulphate, also quite common in all natural water sulphides and which forms the hardest boiler scale. Furthermore, this salt will act as a cement, causing a hard scale formation with salts which ordinarily would form only a soft scale or sludge.

Calcium carbonate, which is only slightly soluble in pure water, but in the presence of carbonic acid dissolves in the water, forming bicarbonate of lime, which is soluble. Alone, however, bicarbonate of lime will not make a hard scale, but when present with other substances, which cement it, a hard scale is apt to result.

Magnesium carbonate is more soluble than calcium carbonate. It is usually found in water as bicarbonate of magnesia and has nearly all the characteristics of calcium bicarbonate.

Calcium chloride, which is very soluble and sometimes found in natural waters. In the absence of other scale-forming salts it is injurious unless highly concentrated. After concentration in the boiler, however, it becomes dissociated and liberates hydrochloric acid, which, of course, is highly corrosive.

Magnesium chloride, a very objectionable salt because it both forms a scale and liberates hydrochloric acid.

Calcium nitrate, having practically the same characteristics as calcium chloride. Waters containing this salt are, however, comparatively rare.

Magnesium nitrate, usually present in only very small quantities and characteristically similar to magnesium chloride.

Sulphates of iron and alumina may be found in waters contaminated with the waste from galvanizing works or with mine drainage and, because of their dissociatiton by heat, sulphuric acid is given off and the iron or alumina precipitated as scale or sludge. These substances are very injurious in a boiler and cause corrosion the same as free sulphuric acid. The oxides of iron and alumina, on the other hand, while usually present in small quantities in nearly all waters, have but a slight bearing on scale formation.

Sodium salts, that is, the sulphates, carbonates, nitrates and chlorides, are all neutral, do not form scale and are non-corrosive, consequently they are not objectionable unless present in large quantities. Silica may also be found in nearly all waters and, while it is a scale-forming substance, yet it is present only in such small quantities that it usually need not be considered.

In addition to all of the foregoing there is always some free carbonic acid in all natural, or raw, water which, of course, promotes corrosion in the boiler. This acid also holds in solution the calcium and magnesium carbonates. Also, if the water contains drainage from mines or galvanizing plants, there is sulphuric acid present in its free state which is extremely objectionable because it attacks the metal in the boiler immediately. This action forms iron sulphate which the heat in the boiler decomposes, resulting again in free sulhpuric acid and iron hydrate. The liberated acid again attacks the metal and so goes through repeated cycles indefinitely. Since this acid is not volatile, its amount in the boiler is naturally increased continually by the quantity introduced with the feed water, so that it can easily be seen how the corrosive action multiplies in intensity and in direct ratio, as it were, with the concentration in the boiler.

Te soluble-scale forming matter may also be divided into two general classes, those causing temporary hardness of the water and those causing permanent hardness. The former consists of the carbonates of lime, magnesia and iron. Their precipitation begins at temperatures approaching 212 deg. Fahr, and they can be entirely removed by boiling the water at atmospheric pressure for a short time. Permanent hardness is due to the sulphates, chlorides, and nitrates of lime, magnesia and iron which will not be precipitated at temperatures below the boiling point, consequently their removal together with that of the acids constitutes the real problem in water purication.

From the fact that a natural, or raw, water can contain such a large variety of impurities in varying quantities, it is evident that the problem is rather complicated and that each specific case must receive individual attention if the sults are to be satisfactory. It should also be remembered that the characteristics of the impurities change under the different pressures and temperatures in the boiler and that their scale-forming properties are largely interdependent. Furthermore, the amount of scale formed does not always bear a direct relation to the amount of impurities in

* Abstract of an article by E. Brown in Metallurgical and Chemical Engineering.

the feed water, but depends on the type of boiler and the rate at which it is operated as well as upon the nature of the impurities. Concentration in the boiler is another factor that enters into the question, since none but volatile matter passes out with the steam, consequently the non-volatile impurities gradually accumulate, forming varying quantitative relation with each other.

Although the scale formed in a boiler is the direct result of impurities in the water, yet an analysis of this scale is of practically no value in determining the character of the water from which the scale was deposited because of the fact that the scale is the precipitation resulting from reactions between some of the substances in solution as well by heat and concentration. Therefore, the original character of the impurities in the water is not always apparent in the scale.

In order to decide on the suitablity of a water, or on its treatment for boiler feed purposes, it is essential that a careful and accurate analysis of it be made. This should be done by a chemist who makes a specialty of such analyses and who is throughly familiar with the characteristics of the water in relation to boiler operation. Unfortunately, however, this is not always done; or the remedy prescribed as a result of such analysis is not carried out. This is evidenced by the fact that scale is still prevalent in many boilers and that the manufacturers of tube cleaners, etc., are still busy making mechanical scale removers. Moreover, there are many compounds as well as mechanical contrivances on the market that are guaranted (?) to prevent scale formation in the boiler, no matter what kind of water is used. Some of these may be efficacious under certain conditions and with certain waters, but as a general cure-all they are an absolute failure.

Use of Boiler Compounds.

One quite prevalent method of preventing scale, or rather trying to, is by the use of boiler compounds, some of which act chemically and others mechanically. Kerosene and crude oil are also sometimes used, but to a much less extent. Graphite is the most common material which acts mechanically and its purpose is to give the interior of the boiler a thin coating which will prevent the adherence of the scale-forming matter to the shell and tubes. It seems, however, that its efficacy under all conditions and for all kinds of water is a matter for honest debate. The compounds which act chemically usually consist of sodium carbonate in combination with some organic acid such as acetic or tannic.

While it is true that in certain specific instances the use of a boiler compound has prevented, or at least reduced, the formation of scale, nevertheless, in order to obtain such results it is essential that the quality and quantity of the compound should be specially adapted to the particular water in which it is used. This makes it extremely difficult to use a compound successfully because of the variable quality of feed waters and the large variation in the amount of water fed into the boiler. As a rule, however, boiler compounds are quite effective in overcoming corrosion because they are usually alkaline in nature and, therefore, neutralize the acids. On the other hand, extreme care should be exercised in using a compound for this purpose because many of them contain corroding agents and consequently are in themselves the cause of corrosion.

Aside from acting as a neutralizing agent for acids, the only function of a compound is to change the nature of the precipitate from one which adheres to the surfaces of the boiler to one which will be carried in suspension in the water. The result is a muddy, insoluble mass made up from the impurities already in the water plus the ingredients in the compound itself. This naturally increases the density of the water and consequently its boiling point is raised because of the fact that the soluble impurities are constantly increased by the concentration resulting from the evaporation of only pure water. This action makes of the boiler simply a catch-all or accumulator for the foreign matter. Furthermore, this accumulation of sludge cannot be entirely removed by blowing off, therefore frequent washing out becomes a necessity. In brief, it may be said that the use of boiler compounds is an attack on the result rather than on the cause and as such should only be followed when no better means of treating the water is practicable.

Soda Ash Treatment Within the Boiler.

There is another method of treating boiler feed water on the market which is similar in principle to the use of boiler compounds in that the water is treated after its introduction into the boiler. This system goes a step further, however, and employs a filter to remove from the boiler water all the impurities held in suspension. In other word, it is a combination of chemical treatment and mechanical filtration.

Soda ash is first introduced into the boiler in sufficient quantities to throw into suspension all the soluble impurities contained in the water. The water containing this suspended foreign matter is then drawn off and carried down through the center of filter which has a collecting space at the bottom. It is then forced upward through a crushed granite filtering medium and returned to the boiler as pure water.

It would seem that a considerable loss of heat would be entailed by the use of this system of water purification, both from radiation and from the loss of the heated water blown out through the blow-off valves. In fact, a loss by radiation is practically admitted by the manufacturers of the apparatus because the assertion is made that a lower temperature in the filter materially assists precipitation, which is completely effected in the upward movement of the water through the filtering medium. That a loss results from blowing out some of the heated water every time the filter is cleaned is, of course, self evident. Furthermore, while this apparatus, if it performs the function intended, will prevent concentration in the boiler, yet the same objections to it might be raised that apply to the use of boiler compounds; namely, it is not good practice to do the purifying within the boiler itself because of its interference with the business of making steam. Any advantages it might have lie in its cheapness, small floor space required, low operating cost, etc.

A Physiochemical Action.

Perhaps the most remarkable and startling novelty in the way of a feed water purifier is what is called a "Luminator." It consists simply of an aluminum plate of specific dimensions and having corrugations thereon of a particular size, both of which are determined by the character of the water to be treated. The treatment is merely allowing the water to run over this plate. It seems that a current of electricity is induced by the passage of the water at certain speeds over the plate and, the water being negative and the plate positive, ionization of the salts takes place. These do not take a crystalline form but become amorphous. It seems there is also another

action which takes place; namely, aluminum is by friction and electrical action abraded from the surface of the plate as a colloid, which, after a period of time, also undergoes a change in the water. These remarkable changes are all brought about without the aid of chemicals of any kind, the whole process being called purely "physiochemical."

Profesor Donnon at the Liverpool University, England, has investigated this process, it seems, and has found that aluminum hydroxide was not present to any appreciable extent in the water treated by this method; but he did find that the aluminum was in collodial form mixed with hydroxide and remained so for several days after treatment. Reports further seem to indicate that the best results are obtained when the so-called "luminator" is facing either north or south and is exposed to direct light! Also that if shut in completely from light and air it becomes almost inoperative. The professor assumes that the earth's magnetism has some effect on the operation of the plate and that if its plane is set so that the earth's magnetic field crosses it there will be produced a small electromotive force at right angles to the grooves of the plate as the water flows down, resulting in a slight electrolytic action and thus precipitating aluminum hydroxide in the solution. He also says that the local electricity, together with a certain amount of chemical action, due to the heretogeneous nature of the metal, are sufficient to explain the surprising and hitherto unknown disintegration of the aluminum. That this explanation is quite clear is more than doubtful.

The foregoing would indicate that boiler troubles resulting from scale formation could be overcome by the simple expedient of installing an aluminum plate and passing the feed water over it. There must be, however, certain limitations to the efficacy of this method of water purification. For example, water containing ferrous sulfate, or large quantities of iron in any form, are not susceptible to such treatment because of the continual deposit of iron on the plate.

Likewise, any acid in the water will not be neutralized, such water requiring a preliminary treatment by passing it over marble or chalk in order to get the desired result. Furthermore, if the "luminator" is at some distance from the boiler it is necessary that the water mains, etc., be coated with a non-conducting composition, such as bituminous varnish, and that the water reach the boiler as soon after treatment as possible. The statement is also made that where the apparatus is used continuously night and day it is advisable to give it a rest of one day per week, otherwise the plate may become "polarized." It is rather difficult to reconcile this statement with the one stating that the plate must be exposed to light to be effective. If the latter is true how can it be used both day and night?

Assuming that this aluminum plate will do the things that are claimed for it, the question is: What becomes of the various impurities contained in the water In reply to this we are told that the various salts in the raw water before and after treatment show, upon analysis, the same chemical composition; that the sulphates and carbonates of calcium, as the magnesium salts, remain as before; and that only a physical change takes place. In a boiler this change is supposed to take place immediately, thus preventing the salts from again going back from the amorphous to the crystalline form, consequently they are deposited as a powder.

This supposed action of the "luminator" and the consequent results obtained therefrom may, perhaps, be quite clear to the inventors, but to the writer it certainly savors of mystery and magic. In other words, this "luminous" treatment of water is not very illuminating and the claims supporting it are far from convincing. At all events there will no doubt be considerable "missionary" work required before it receives anything but the most skeptical consideration.

Water Heater-Purifiers.

One of the common methods of attacking the problem of scale fomation in the boiler is by pre-heating the feed water. This method is based on the well-known fact that raising the temperature of water reduces the solubility of some of the salts in solution. The apparatus used for this purpose is the "feed-water heater and purifier," and is designed to receive the deposition of the scale-forming substance intead of letting them enter the boiler itself. That it will fulfill this purpose to some extent is unquestionably true, but whether it completely solves the problem or not it rather doubtful.

There are two kinds of heater-purifies on the market, both of which are supposed to intercept the impurities in the water. One is the open or exhaust steam heater into which only exhaust or low-pressure steam is introduced to heat the water, and the other is the closed or live-steam heater in which steam at boiler pressure is used. In the first, of course, the temperature of the water cannot be raised to more than 212 deg. Fahr., boiling point of water at atmospheric pressure. It is also obvious that in this type of heater only the temporary hardness of the water will be effected and that only partially, because precipitation is a gradual rather than an instantaneous process and the length of time the water is usually allowed to remain in the heater is not sufficient to make the precipitation complete. To overcome this difficulty the size of the apparatus has lately been increased so as to allow the water to remain longer; and in some instances softening reagents have been introduced and a filtering device attached. These steps taken by the manufacturers are an indication that the old type of open, exhaut heater-purifier does not fully meet the requirements.

The closed type, or live-steam apparatus, on the other hand, will remove practically all of the temporary hardness but not all of the permanent hardness. While it carries practically the same pressure and temperature as the boiler, yet to precipitate calcium sulphate, for example, a certain amount of concentration is necessary in spite of the general assumption that this salt is insoluble at temperatures above 300 deg. Fahr.

The real function of a heater is to heat the feed water and as such both types are very successful. As a purifiier, however, it does not quite come up to requirements, although it must be given credit for doing some good. In the same sense that a feed-water heater is also a purifier so might the boiler be called a purifier because scale deposits in both. Aside from heating the water, the advantage in the heater is that this deposit is more easily removed than from the boiler. provided, however, it entirely purifies the water so there will be no deposition at call in the boiler.

Chemical Water Softening Systems.

Any method or apparatus for softening and purifying water in a satisfactory manner must be such that the acid contained will either be eliminated or neutralized; the permanent hardness removed and any remaining scale-forming substances reduced to a negligible quantity. It must also produce a clear effluent. If these results are not obtained, then the method employed is either wrong in theory or ap-

plication, or the apparatus is faulty in design or operation or both. Of course, to properly treat water is a rather delicate process, more so perhaps than might be generally believed. This is because of the small relation the amount of impurities, which have to be removed, bears to the volume of water to be treated. Therefore, to get results, an accurate analysys of the water is of prime importance for determining the treatment and the apparatus required.

Without doubt the most satisfactory and efficient manner of treating feed water is by means of proper reagents introduced in order to meet every variation purities, followed by the complete clarification of the water by sedimentation and filtration. The apparatus on the market that operates on this principle is commonly called a "water softening and purifying system." There are two types of this apparatus, one called the continuous and the other called the intermittent. Either one will produce good results if given proper attention.

In the continuous system the reagents are introduced by proportional feed devices, usually actuated by the water entering the system. The water enters either at the top or bottom and flows out by displacement at the same rate at which it enters. An adjustment must, therefore, be made in the quantity of reagents introduced in order to meet every variation or change in the water. Unless this matter of adjustment is watched carefully there probably will be times when the water is overtreated and other times when it is undertreated.

In the intermittent type, on the other hand, the water is always treated in measured quantities, and the exact quantities of reagents required are weighed out; therefore, any water can be treated most accurately, no matter how it may vary in quality or quantity. But, as compared with the continuous system, it requires much more ground area, more expensive foundations, and possibly a little more labor to operate.

However, it is not the intention to weigh the advantages, or otherwise, of the one system against those of the other, because, as said before, if properly attended to, either one will give results, as attested by the fact that there are a great many of both kinds not only in use but also are being sold at the present time.

As a general rule the reduction of the scale-forming impurities to 5 grains per United States gallon and the elimination of the acids is considered good practice. There are, however, cases where it has been found necessary to reduce the scale-forming substances to less than 3 grains to prevent scale, and others where good results are obtained with as high as 6 to 7 grains. It is impossible, of course, to remove all of the substances, as calcium carbonate and magnesium hydrate are slightly soluble at all times. Nor is it possible to take out any sodium salts except by distillation, because they are all soluble and no chemical treatment will throw them into suspension. In properly treated water, however, they do no harm to the boiler as they are neutral, non-corrosive, and non-scaling.

The reagents commonly used in these water-softening systems are lime and soda ash, although other substances are sometimes used, depending upon the nature of the water. The cost of purifying will, of course, depend upon the amount of reagents required, for it is readily understood that it will require more chemicals to remove 30 grains of some impurity than it will to remove 10 grains. Almost any expense, however, incidental to the proper softtening and purifying of water for boiler feed purposes is more than offset by the savings that result.

In conclusion it might be observed that the limit of possible economy is much more distant in the boiler house than in the engine room and that the first essential in economy of boiler operation is that the water should be of a quality which will permit of the utilization of the greatest number of heat units in the fuel, at a minimum cost of boiler maintenance. In many steam plants may be found the most improved design of boilers, with mechanical stokers, stack dampers, feed-water regulators, feed-water heaters or economizers, and no doubt the must economical prime mover obtainable in the engine room; but the matter of pure water is often totally neglected.

Yevesia Mines, Oaxaca.

The gold and silver mines of Yavesia are situated in the municipality of Xicaui, in the Ixtlan district of the State of Oaxaca. They are thirty-seven miles from the city of Oaxaca, the nearest railway station. There is a wagon road for the first thirty miles out from the city of Oaxaca and a good pack trail the rest of the way, over which machinery weighing 5000 lb. has been transported. The elevation is from 6500 to 8000 feet. The climate is pleasant and healthful and work may be carried on the year around. Oak and pine timber are plentiful and may be obtained within a mile or so of the mines. Several native villages are within a couple of miles and labor is cheap and abundant. A post office is within a mile and a telegraph station within six miles.

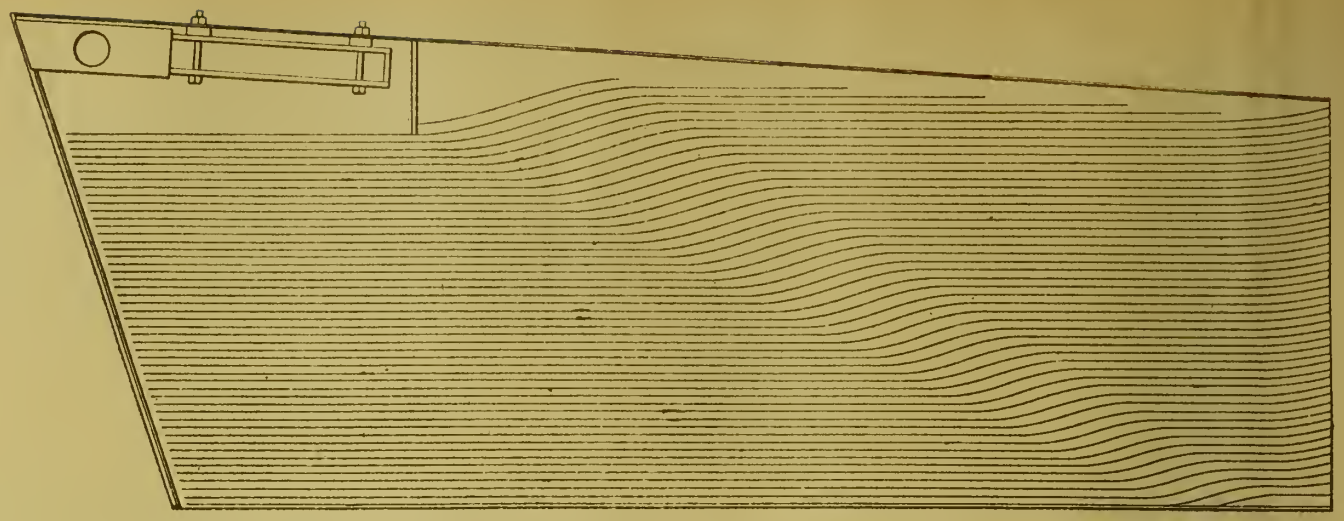
There are eighteen mines, all duly titled, known as Las Animas, San Joaquin, Demasias de San Joaquin, Rosario, San Rafael, Banco Real, Manchega, Continuación de Manchega, Veta Amarilla: Veta Clara, Soledad, Veta Negra, La Purisima, Don Jaboco, San Antonio, Cruz del Monte, Don Pascual, Extensión de Purisima, and containing 90 pertenencias, or 222 acres. The mines are in one body and extend from the Yavesia river up the hill to the north to the summit, a distance of 5000 feet, and down the other side for a distance of about 1500 feet. The difference in elevation between the stream and the top of the hill is approximately 1500 feet.

Old maps (1830-40) show extensive works on Soledad and Purisima; other maps (1875-80) show works on Manchega, Santa Cruz, Santa Gertrudis, Natividad, and San Antonio; and the maps show the workings on the Manchega and San Joaquin now accessible together with the most important mines in the district.

In the Manchega mine there are four veins called respectively San Francisco, Manchega, Rosario and Providencia; while on the San Joaquin mine one more vein is known, called San Joaquin. All of these have been worked to some extent. The deepest works are between six and seven hundred feet from the surface. All of the veins have produced high grade ores.

Milling values are found in the Santo Niño incline and drift and much milling ore is said to be in the old workings above and to the north. Good ore is said to be in three winzes below the San Juan level and milling ore is to be found in the old stopes above the winzes.

In connection with the mines are two old Haciendas de Beneficio, where ores were treated by the patio and Freiberg barrel processes, after crushing by wooden stamps with iron shoes. Later, arrastras were used on the ores carrying the greater part of the values in gold. Each of the Haciendas has a water right on the Yavesia stream, and one of these water rights will furnish the power for the plant now partly installed.



The Butchart System of Curved Riffles for Wilfley Tables.*

By David Cole, Morenci, Arizona.

The appearance of the Wilfley table in 1897 marked an epoch in the art of the concentration of ores. The table has merit and received an almost unprecedented measure of public approval, lasting through its whole patent life. It has been very little improved in itself, or improved upon by competitors. The new machines bidding for popular favor have been of the Wilfley family, but without ability to do markedly better work than the parent machine, or to do more work except by the use of superimposed decks, the latter having obvious disadvantages.

During the past three years there has been developed at Morenci a new type or arrangement of riffles applicable to the Wilfley type of concentrating table which corrects many of the objectionable features or limitations of the older system and obviates most of the difficulties encountered with it, particularly when handling ores having a low ratio of concentration. The new type is known as the Butchart or National riffle system and its general arrangement is shown in the accompanying diagram.

The old system accomplished stratification satisfactorily but has insufficient means for separating the strata. The new system not only stratifies the minerals but is provided with ample means for segregating and separating them. The old system has a single cleaning channel, or zone, consisting of the diagonal depression adjacent to and parallel with the successively advancing ends of the riffles, and this is easily overloaded in a way to defeat in large measure the object desired. The new system has as many individual cleanning channels as there are riffles upon the table, and these are not easily overloaded because they are filled in succession and back each other up.

The old system is not adapted to the handling of very coarse table feeds, stopping for good work at about 2½ mm. size, while the new system handles very large tonnages of what have hitherto been jig sizes, with a much simpler arrangement of machinery and with greatly improved general results.

* Abstract of a paper read before the New York meeting of the A. I. M. E. February, 1915.

Advantages of New System.

The new system eliminate the necessity of hydraulic classification beyond the desliming stage. Desliming or classification of any kind is not required on coarse feed because the table rejection is usually dewatered and reground for future treatment, and when either primary or reground material is to be handled it is necessary only to remove thoroughly the slime either in spitzlutte or drag classifiers. When classification is carried further than this too much of the fine sand is eliminated, with detrimental effect upon the work of the new table.

The new system requires less water than the old. The water consumption of the new system is from 250 to 275 gal. per ton of feed; therefore, when these tables displace jigs the water consumption is reduced from 50 to 75 per cent., and when used instead of the old system it is reduced approximately 50 per cent.

With these advantages the new system is very important in wet concentration, particularly where the ratio of concentration to be practiced is medium or low, and when used in conjunction with a successful flotation treatment of colloid overflows it makes possible the construction of a most desirable wet concentrating plant, adapted to large tonnages in relatively small space, and for a minimum capital expenditure per ton treated.

In developing the table at Morenci, it was first recognized that the Butchart system of riffles gave great stability to the operation of tables under varying conditions of feed and water. Suddenly increasing the quantity of feed would not interfere with the ability of the table to make clean concentrate, and it was not necessary continually to be making adjustment of the table slope in order to bring the concentrate to the proper cutting-out point. These differences were in great contrast to the old system and discounted the indifference plus carelessness of the average operative now found in large mills. This consideration alone was considered sufficient to justify the adoption of the new system in the Arizona Copper Co.'s No. 6

Concentrator, where this system of riffling has since been evolved into its present form.

At first the riffles were thin and the ultimate capacity of the table was unknown. Discoveries in the matter of capacity came about rapidly through experimentation. For example, it was found desirable to reduce the insoluble material in Hancock jig concentrate, which was a mixed product ranging in size from 3/8 in. down to 200 mesh, containing 15 per cent. copper and 30 per cent. insoluble. The standard No. 5 Wilfley table was first installed for his work, but it was found impossible with this system of riffling to handle successfully the range of sizes or the excessive and variable tonnages coming from the jigs. Butchart strips were then substituted for the Wilfley riffles. These strips were thicker than usual, purposely making deeper channels, and it was found that very little work of adaptation was required to get excellent results. Heavy tonnages could be treated with a minimum amount of material sent to the middlings; the table responded to great variations of load; the insoluble material was reduced to less than 15 per cent.; and the coarse concentrate, instead of working down and arranging itself in the rear of the concentrate band, as it does with the Wilfley riffle, was discharged out of the top riffle into the concentrate launder; and time samples showed that the table load averaged about 80 tons per day.

Experiments were then tried on coarse unclassified feed up to and including the undersize of 4-mesh screen affording square openings of 3/16 in. size. This feed had a concentration ratio of 15 into 1, and it was found that as much as 200 tons per day could be handled successfully, making clean concentrate containing a range of sizes from 3/16 in. to 100 mesh and finer.

The plant was being operated at full capacity during a period of reconstruction and it became necessary to remove the intermediate Hancock jigs and to crush the primary-jig rejections in one operation in 8-ft. Hardinge mills direct to 20-mesh size for treatment on sand tables. A paddle-wheel classifier, which was a fairly good deslimer, was in use following the Hardinge mills. Floor space was limited by construction operations and but few tables could be accommodated at the time, so a few of the new ones were fitted with somewhat thicker Butchart curved strips, and the relatively rich product of the paddle wheel was fed upon them to what appeared to be maximum capacity, as judged by the appearance of the concentrate and panning of the tailing. Time samples then brought out the surprising fact that the tables were often handling more than 100 tons each, which was three times the load of neighboring Butchart machines and five times the load of ordinary Wilfley riffles, and were making concentrate carrying but 17 per cent. insoluble, with averages as follows: Feed, 95.2 tons, 2.10 per cent. copper; concentrate, 17.70 per cent. insoluble, 15.83 per cent. copper; tail, 0.86 per cent. copper; ratio, 12.1 into 1; extraction, 62.4 per cent.

The subsequent adoption of his system in a neighboring mill has greatly simplified the operation in its primary stages and has reduced costs without detriment to final metallurgical results. In making the change 10 of the No. 5 type Wilfley tables were rearranged for use with the Butchart riffles, and eight of these handle the complete ore tonnage with astonishing results, making it possible for the company to so change and simplify its flow sheet as to dispense with the use of a large amount of machinery with its accompanying expense for repairs, power and operation.

For more than a year the eight primary tables referred to have been handling an average of 1,600 tons of feed per day, the feed consisting of the undersize of 7-mm. screens, going to the tables without desliming, classification, or other preparation, with the typical results—the average of a long period—which follow:

Tables with Butchart Riffles.

Head		Concentrate				
Tons Each	Per Cent. Cu	Per Cent. Cu	Per Cent. Insoluble	Reject. Per Cent. Cu	Per Cent. Recovery	Ratio
160	3.15	16.65	9.8	1.42	60.04	8.8:1
Group of Harz Jigs (at same time).						
35	3.19	17.43	11.9	1.63	53.95	10.1:1

The reject from the above was reground to 1½ mm. size, deslimed by drag-belt classifier, sand treated on Butchart riffles and same sand simultaneously on standard Wilfley riffling, with the following comparative results of four days' continuous sampling:

One Table with Butchart Rifles.

Head		Concentrate		Rejections: Midd	Tail	Midd. and Tail		
Tons	Per Cent. Cu	Per Cent. Cu	Per Cent. Insol	Per Cent. Cu	Per Cent. Cu	Per Cent. Cu	Ratio	Per Cent. Recovery
101	1.66	12.46	11.3	0.91	0.55	0.61	11.3:1	66.50

Comparative saving and loss: Middling, 6.94 per cent.; concentrate, 66.5 per cent; tail, 26.56 per cent. Water consumption, 16 gal. per minute, 256 gal. per ton.

One Table with Wilfley Riffling.

Head		Concentrate		Rejections: Midd.	Tail	Midd. and Tail		
Tons	Per Cent. Cu	Per Cent. Cu	Per Cent. Insol.	Per Cent Cu	Per Cent. Cu	Per Cent. Cu	Ratio	Per Cent. Recobery
35.5	1.47	13.21	10.9	2.26	0.59	0.76	17.5:1	51.25

Comparative saving and loss: Middling, 14.75 per cent.; concentrate, 51.25 per cent.: tail, 34.0 per cent. Water consumption, 12 gal. per minute, 867 gal. per ton.

A table with Butchart Riffles was afterward tested against a group of five standard Wilfley tables, the latter handling as nearly as could be gauged the same tonnage as the one Butchart, with the following averages for four days' continuous sampling:

One Table with Butchart Riffles.

	Head	Concentrate		Rejections Midd	Tail	Midd. and Tail		
Tons	Per Cent. Cu	Per Cent. Cu	Per Cent. Insol	Per Cent. Cu	Per Cent. Cu	Per Cent. Cu	Ratio	Per Cent. Recovery
96.8	1.57	14.32	17.4	1.00	0.74	0.79	17.3:1	52.58

Comparative saving and loss: Middling, 11.54 per cent.; concentrate, 52.58 per cent.; tail, 35.88 per cent.

Five Tables with Standard Wilfley Riffles.

	Head	Consentrate		Rejections Midd.	Tail	Midd. and Tail		
Tons to 5 T	Per Cent. Cu	Per Cent. Cu	Per Cent. Inso.	Per Cent. Cu	Per Cent. Cu	Per Cent. Cu	Rotion	Per Cent. Recovery
115.9	1.39	15.20	16.8	1.55	0.68	0.81	24.8:1	44.07

Comparative saving and loss: Middling 15.99 per cent.; concentrate 44.07 per cent.; tail 39.94 per cent.

It will be noted in these tests that the insoluble is slightly higher in the Butchart concentrate. This is because this type of riffling cuts more oxidized copper into the concentrate than the Wilfley system does. The saving of this oxidized mineral at this stage is very advantageous, for it is as high in copper as milling can make it, but being lighter it goes off in the Wilfley system in the middling and thus raises the copper content of the rejections and increases the ratio of concentration at the expense of the extraction. It will be noted further that the Butchart riffle system has evidently removed all the free mineral from what would be the middling zone to the concentrate. Of course, the Wilfley middlings could be re-treated and the free mineral removed, but this complicates the operation and is unnecessary when the Butchart system is used. Middling on the Butchart system is a true middling, consisting of grains needing further crushing to free the mineral, together with the lighter part of the oxidized mineral, etc., and with a small amount of free but very fine mineral grains. The middling on the Wilfley system consists of the above, plus what free and relatively coarse mineral the cleaning zone, on account of its overload, has failed to separate.

In another plant and district, on a type of ores very different from those of Morenci (having no water-soluble oxidized or carbonate copper), loads as heavy as 200 tons per day of thoroughly deslimed but otherwise unclassified feed, being the undersize from 1½-mm. screens, assaying an average of 1.34 per cent. copper, have been treated with an extraction of 54 per cent. of the copper content, as compared with an extraction of 38 per cent. effected upon tables running in parallel out of the same launder but equipped with a modified Garfield system of riffling. The concentrate in each instance was cut to 20 per cent. insoluble, which is the smelter standard worked to in this case. The rejections of the Butchart table contained very little copper except in the form of attached mineral, while the other tables rejected much free mineral, through inability to clean and segregate it to the concentrate launder.

The modification in the Garfield system of riffling above referred to consisted of cutting off the ends of the riffles diagonally on the concentrate corner of the table to make a cleaning zone there, at the same time retaining the deep channels of the Garfield system.

If the Butchart riffles were to be straightened out, i. e., laid without curves, the result would be the Garfield system of riffling, and it will be realized that the table would then require more side slope to prevent the whole load from going over the concentrate end; and on account of the violent agitation produced when enough side pitch is given to the table to carry the sand into the tailing launder properly, the fine material will not have a good chance to settle and much more of it will go over into the rejection than would be the case when the curves are used, for with the new system the side slope is such that a gentle rolling over of the load is accomplished. The movement of the load bodily along toward the concentrate end is checked by the curves and these enrich the product passing them to whatever extent the plan of operation requires. Thus the Butchart system makes a superior roughing as well as a superior finishing table. When simple roughing is the work to be done the curves are modified to suit that class of work.

In another district a company has installed a "pilot mill" to determine the best flow sheet adapted to its ores. It has developed in this mill that two Butchart tables handling the drag-belt deslimed product of Hardinge mills, assaying 1.35 per cent. copper, ratio 8.5 into 1, are making concentrate averaging 9 per cent. copper, 8 per cent. insoluble, 32 per cent. iron, and with middling plus tail that will average 0.35 per cent. copper. The extraction in this case is from 75 to 80 per cent. of the copper present.

In this pilot mill the roughing out of the concentrate the first separation stage above the regrinding mill is

done on a Butchart table on unclassified and not deslimed feed that has passed a 7-mm. screen, with the same generally good results as to production of finished concentrate that have been noted in the previous cases.

This pilot mill is proving that with a simple arrangement of crushing machinery reducing the ore to 7 mm. for the first separation by the new system, the rejection through regrinding mills for finished reduction, desliming of the reground sand, treatment of the sand over Butchart tables and of the slime by flotation, a very high percentage of the total value will be recovered. Most of the final rejections are made from Butchart tables and are sand tailing containing the minimum amount of copper noted above, indicating very cheap costs for construction of plant and, on account of its simplicity, very simple and inexpensive operation throughout.

Operation Analysis.

In order to understand the marked change in table conditions brought about by this new system of riffling, it is necessary to analyze in some detail the method of operation in the old system and compare it with the new one.

In the work of each system the coarse and more cubical pieces are more free to move and more easily rolled by the carrying water than are the smaller and flatter particles, and their arrangement upon the table is in accordance with the law governing the angle of repose of particles partly suspended in water. The tilt sidewise given to the table causes the wash water to move more speedily and also provides more slope to assist the rolling-over action of the mass being treated, with the result that the coarse particles of low specific gravity go clear across the bed of pulp upon the table and arrange themselves in the rear of the mass moving forward, while the successively smaller sizes, with those having successively greater specific gravity, tend to arrange themselves farther up on the slope and farther along toward the discharge end. Thus the forces at work tend to arrange the bed upon the table with successively smaller grains from rear to front and successively lighter grains from bottom to top. The differential motion moves the whole mass lengthwise, while gravity is rolling it crosswise the table deck, and the heavy bottom stratum of mineral consisting of medium-sized and fine particles appears first upon the cleaning zone of the Wilfley system, and goes farthest up the slope against the influence of the dressing water tending to wash it back.

Each channel of the Wilfley system properly stratifies its portion of the minerals and then becomes a conveyor to bring the mineral strata under the influence of the wash water in the single diagonal cleaning zone just beyond the ends of the riffles.

When the quantity of mineral of high specific gravity is in a relatively small proportion, the recoverable portion of it is pushed forward in the grooves by the differential movement beyond the terminals of the riffles into this zone, where it encounters the clear water on a new slope and where it is rolled over itself, while the fine sand is eliminated in the process of dressing, the finer and heavier particles finally occupying the thinnest edge nearest the wash-water box, the coarse working down and arranging themselves in the rear of the mineral band. This is the situation desired and the one that results in good separation, but this action cannot take place except where the layer of mineral is sufficiently small in volume so that it can all be cleaned outside and beyond the ends of the riffles; which means that if the separation is to be satisfactory the table must be fed with tonnages affording only the amount of concentrate which the limited cleaning zone can successfully handle, and that if larger tonnages of low-ratio material are handled the cleaning zone will fail proportionately with the overload, the clean mineral stratum will not emerge from the riffles and will be covered by the middling stratum to a large extent, and therefore will go off as middling, or to the detriment of the concentrate if cut out with that class.

With the Butchart system the entire surface of the table is covered with riffles which are made to perform useful work. Each of the channels becomes a distinct separating device which cleans its own concentrate in the curve between the riffles instead of upon a smooth unriffled surface. It has the ability to perform this function on the upper one-half of the deck, on the large quantities of concentrate produced, the balance of the surface being free to treat the more difficult portion of the concentrate, to clean up middling, and to be ready to handle large quantities of concentrate when the load or ratio fluctuates.

The riffles extend the full length of the table, are exactly alike as to dimensions, and taper from the rear, or mechanism, end to the front, or discharge, extremity. For average operations they usually taper from a height of ½ in. at the rear to ⅛ in at the front end. These dimensions are varied to provide such concentrate-carrying capacity as may be demanded by the average ratio of concentration in the material to be treated. They may be, if required, 1 in. in the rear, tapering to ⅜ in. at the tip, or discharge, end. The curved deflection of the riffles together with the transverse inclination of the table produces in the curved channels a downward slope toward the rear, or mechanism, end of the table, and the contents of the channels have to climb up this slope against a gentle stream of water passing down it. As the channels in the cleaning zone are not parallel to the direction of motion, the straight-line movement of the table causes a circular agitation or side shake to be imparted to the contents of this portion of the channel, subjecting all of the contents to a vanning action which causes the fine silica content of the strata to pass down the channel with the clear wash water and to pass over at the lower end of the curve, and, notwithstanding a great variation in the concentrate sizes, effectually cleans the concentrate while climbing up the slope. At the discharge end of the riffles there is usually another curve, which serves the purpose of preventing too large a portion of the dressing water from falling over the end of the table with the concentrate. This is for assuring a steady and even flow of water completely across all of the parallel channels of the table below the wash-water box so as to produce a steady and even flow of water down the channels in the cleaning zone. The terminal curves are indispensable when the riffles have a thickness of from $^{3}/_{16}$ to ⅜ in. at the discharge extremities of the table.

The stratification and removal of concentrate is so rapid that most of it goes off in the upper one-third of the table deck in 12 to 15 riffles, depending upon the ratio of concentration. The remaining mineral is successively less in volume and is cleaned and brought forward in the larger area farther down the table, and is lighter and successively poorer in grade. Thus there is a large space, between the main concentrate discharge and the silica rejections, which is occupied by a small quantity of relatively poorer concentrate, and there is no large accumulation of concentrate near the middling corner as in the old system. The feed on the middling corner of the table has become so thoroughly impoverished that it is sometimes found necessary to take the contents of several of the lower riffles into the middling.

The effect of the uniform feed and water distribution over this completely riffled table is to produce uniform velocities in the water moving on the zones each side of the cleaning curves, with an excellent classification of the feed upon the main body of the table. As previously mentioned, the sands arrange themselves in successively decreasing sizes from the rear toward the middling corner, and the perfection with which this action occurs is found to be an excellent visual guide in judging the work that the table is performing. The better the classifying action noted the better the recovery will be.

In ores affording low ratios of concentration, the sulphide minerals present are usually massive and coarse concentration is usually practiced and in their anxiety to avoid sliming of the sulphides engineers try to remove them in several stages, each adding materially to the complication, cost of construction, maintenance, and cost of operation. The instance quoted in this paper shows that it is not always necessary or economical to have several stages in the roughing-out process, and the author believes that it is seldom advisable.

Roll crushing down to 5 mm. size does not require choke feeds and does not slime the minerals excessively. It is the reduction in regrinders that produces slime rapidly. There is no evidence to show that reducing a ½-in. cube of sulphide mineral in crushers or rolls into 100 or more fragments passing a 5-mm. screen, in preparation for a single-stage treatment. will result in the production of more colloidal mineral than is produced in the trommels and jigs of a more complex system using more stages, and in the light of the work accomplished and recorded the proposal to simplify the operation by crushing directly to roughing-table size does not seem illogical.

Mining District of Asientos, Aguascalientes.

The Asientos district is located about 40 miles northwest of the city of Aguascalientes. The mines are about 5 miles from the nearest railroad stations, San Gil, on the San Luis Potosi branch of the Mexican Central, and Cobre, a spur of the main line of the Mexican Central. The distance to the nearest smelting works is 40 miles from the American Smelting and Refining Company plant, at Aguascalientes, and about 75 miles from the works at San Luis Potosi. This insures low freight rates and makes it possible to ship lowgrade ore.

Character of Deposits.

The main dike strikes across the district in a direction of about 30 deg. northwest-southeast, but at the most southeastern point of the camp it breaks up into three main vein systems, each of which again splits into numerous smaller veins. The three main splits strike about as follows: One, the most western, north about 45 deg. west. On this system are located the Guggenheim mines at Cobre and the Fortuna mines at Santa Clara. On the other two systems the mines at Asientos are located. The western and middle mines are the copper-ore producers, striking about 10 deg. northwest, with numerous smaller branch veins varying from north 10 deg. east to north 50 deg. west, and the most eastern system strikes about north 55 deg. west. This latter produces a silicious lead-silver ore of good silver grade and large, fairly uniform width. The general dip is from 60 to 75 deg. to the southwest.

The whole district outcrops plentifully with good surface indications, and has been prospected very little and for only about 4000 m. of its length.

The formation of the district is a gray-black limerock along the copper-producing veins, while the lead-silver split has a surface capping of rhyolite to a depth of about 200 m., varying from pinkish color at the surface to a more compact olive green in depth. Below this depth the limestone formation has been encountered once more, indicating the rhyolite to be a later local flow of limited extent. As the deepest workings in the district are one shaft at the lead-silver property of the American Smelting and Refining Company, the Santa Francisca mines, which shaft has passed through the surface rhyolite, and is now in the country limerock, comparatively little is known of the geology of the district. The deepest workings in the copper deposits are only about 125 m., and are still in the limerock exposed at the surface.

Santa Francisca Mines.

The Santa Francisca mines on the most easterly split, are by far the largest and most developed in this district. It is an "Antigua," and records tell of work having been done 200 years ago by the Spanish priests. A considerable accumulation of water in the old workings was at first encountered, but the property is now thoroughly unwatered and work is being carried on vigorously. The mine is pumping about 600 gal. of water.

The upper three level workings are all in rhyolite, but at the fourth level, limerock was encountered. Through this a crosscut has been driven toward the vein. The rock encountered in this crosscut changed to a carbonaceous shale, much foliated and slickensided. The vein has, however, been reached and is producing ore, although the output is retarded because of the large amount of water encountered.

The vein matter is silicious, having a banded appearance, the bands alternating from quartz to lead-zinc streaks. The vein varies in width from 5 to 40 ft., with an average of about 20 ft. of ore. The lead. 2 to 3 per cent. being the average, carries most of the silver, about 1 kg. per ton, the zinc content being small, about 3 to 5 per cent., and silica about 58 per cent.

Mining has been carried on with square sets, owing to the loose ground in the old workings, but the country rock is sufficiently strong to omit timbering in virgin ground. All the ore is hand-sorted on the patio and shipped to the smelter at Aguascalientes by the Mexican Central Railroad, from San Gil, the mine's 10 kilometer railroad carrying the ore to the bins at San Gil station.

The output it steadily increasing, and will be very much augmented by the stoping ground to be opened in the fourth and fifth levels, in which latter crosscut is now being pushed from the main shaft toward the vein. The mine is owned by the American Smelting and Refining Company.

Merced y Anexas and El Orito.

The largest copper-producing property is the property of the Aguascalientes Metal Company. It is located on the central vein system and consists of the

Merced y Anexas and El Orito claims. Albert Doerr, the manager of the mine, who furnished the data given below, states that the present company has been exploiting the property for the past eight years. The Merced property has two veins, averaging 3 and 5 m. in width, the ore occurring in lenticular shoots. The silica content of the vein filling increases with depth, the average ore running 3.5 per cent. Cu, 250 gram Ag, and 5 gram gold per metric ton.

The ore is mined mostly by overhand stoping, being hoisted by electric power from one shaft and by horse whim from another, which has now been replaced by an electric hoist. Practically no timbering is required underground. The ore is shipped to the railroad by burros and carts, the property at present shipping 1500 to 1800 tons per month to the Aguascalientes smelter, its ore shipped by burro going to the Guggenheim branch railroad at Cobre, and the carts carrying the ore to San Gil over main wagon road, a distance of about 5 miles.

The Asientos Mining Company also owns several properties on the same vein and some of its branches. Its principal claims are the Nopensada, Alta Palmira and Veta Grande.

The Nopensada and Alta Palmira mines are "Antiguas," the latter, according to reports, having furnished very high-grade silicious silver ore below its surface copper ore. Its old square masonry shafts are filled with water, and no work has been done for several years. Several prospects on the Alta Palmira vein have recently encountered good ore and bid fair to become good properties if properly developed.

The Nopensada is a copper producer, and before its shutdown shipped considerable ore, although no great depth has yet been obtained. The new company is now unwatering the mine and expects soon to be operating again.

A few prospects in the district, the Los Angeles, Lulu, Mascota, Patricio and Tepozan, especially on the branch vein called "Alta Palmira vein," are opening good ground, and good ore has been encountered in some of these prospect shafts and workings at comparatively shallow depth. With a reasonable outlay of money spent in systematic development work, the prospects in the camp should rapidly become producers. Some good ore has also been encountered on the extension of the Santa Francisca vein, by some new prospects working on this siliceous silver vein system.

The town of Asientos is located in a beautiful valley about one and a half miles from the mines, and has a population of about 3000. The American colony in the camp numbers about 30 people, and supports an American school. The elevation is about 7000 ft., and the climate is most agreeable throughout the year. The San Gil railroad station of the San Luis branch of the Mexican Central, is about four miles from the town, and the Cobre station on the spur of the main line about three miles.

Labor is of fair grade, the miners coming originally from the Zacatecas camps, and there is no difficulty in securing sufficient labor at a reasonable price. Most of the work is done on contract or meter system, the miners receiving from $1 to $1.50 per meter drilled on the latter system.

Because of its ideal climate, plenty of labor, its nearness to both railroad and smelting works, the camp offers unusually favorable opportunities for the mining of its low-grade ore. The present lack of development of the camp is due to lack of outside capital for vigorous working of the prospects in the district, but several companies have taken up considerable property lately, and before long activity on a larger scale than heretofore is confidently expected.

Feldspar a Posible Source of Pothash.

By Allerton S. Cushmand and Geo. W. Coggeshall.

Muriate of potash is the chief potash salt imported in America. It is sold on the basis of "80 per cent. muriate," and usually contains from 70 to 80 per cent. KCl, or from 44 to 50 per cent. K_2O. This material, having its values in such a small bulk, will bear the cost of freight shipment easily. It is the cheapest potash sold for use as a raw material for chemical manufacturing, and it is also well adapted for mixing into general commercial fertilizers. Any potash salt, however, running not less than 17 per cent. K_2O (or 26 per cent, KCl) is adapted for use in mixed fertilizers. A salt lower than 17 per cent. K_2O could only be used where the final K_2O content in the complete fertilizer was to be less than 5 per cent.

Therefore, for the uses of the fertilizer industry, the economical production of any material containing 26 per cent. or higher of KCl, would find large use, but for the replacement of all or a portion of the one million dollars' worth of concentrated muriate salts used yearly in the United States for chemical manufacturing, it is necessary to produce a salt containing at least about 70 per cent. KCl.

A comparatively small quarry of feldspar, containing 1,000,000 cu. ft. of rock, or 100 ft. in cube, would contain 17,000,000 lb. of potash (K_2O) which, if it could be extracted, would be worth even at ante-bellum prices, $700,000. One ton of such an ore would contain 200 lb. of potash, worth, if it could all be extracted, about $7. If we assume, however, that only 75 per cent. of it would yield to a chemical engineering process, we still have $5 per ton in value to work for. When we remember that in large scale operations in the gold mining industries, quartz that carries no more than $2 per ton in valuable constituents has been profitably worked, the problem need not necessarily frighten us away at the outset.

During the fiscal year ending June 30, 1914, there was imported into the United States $15,000,000 worth of potash salts, kainit, manure salts, muriate of potash, and sulphate of potash. In addition to this, considerable quantities of caustic and carbonate of potash, not included in the later available statistics, were also imported. Of the total, $8,000,000 worth was muriate of potash. The fertilizer industry uses, of course, the larger proportion of these potash importations, the percentage in the last few years being about 85 per cent. of the total of muriate of potash imported, there being left about $1,000,000 worth of muriate of potash which was used in industrial work. About half of this total, or $500,000 worth, was used to make caustic potash and carbonate of potash. These are used prin-

* Extracts from a paper read before the American Institute of Chemical Engineers.

cipally in the soap industries, although a large portion is used as a wrapper-tobacco fertilizer and in the manufacture of glass, paper, preparation of colors, in printing, in photography and in more strictly chemical industries. Some nitrate of potash is manufactured from the chloride. About one-eighth of the muriate is manufactured into chlorate of potash at present, which is largely used in the growing safety-match industry. Potasah bichromate uses about one-twentieth of the muriate and this is used in textile and color industries, also in photography.

A process for the production from feldspar of potassium chloride salts similar to the concentrated muriates imported from Europe is as follows:

A mixture of ground feldspar, containing about 10 per cent. of K_2O, and burned limestone, is formed into rounded aggregates or "clumps" about 1/4 in. in diameter, using a solution of calcium chloride for this purpose. Calcium chloride is the by-product of the ammonia-soda alkali process and is the reactive agent in unlocking the potash from the slica. It was found that a proportion of burned lime mixed with the powdered feldspar will unite with $CaCl_2$ from a solution sprinkled on the powder, to form an oxychloride compound which cements the whole powder into aggregates, giving such a very intimate union of the particles that when heated the reaction yields are high. These aggregates or "clumps" pass directly into the rotary kiln heated either by oil or powdered coal flame. The clumps fall out of the kiln in the same form in which they entered it, but the potash has been converted from the insoluble form into the water-soluble muriate. These red-hot clumps fall into water in leaching vats, where the potassium chloride goes into solution. Several of these leaching vats are used so that the solution of the salts, the leaching, washing, etc., is continually perfomed. The strong solutions are pumped to the evaporators. The weaker wash liquors are used as leaching liquids for a new lot of processed clumps. The strong liquor containing roughly 10 per cent. of KCl will be continuously sprayed down through the hot gases. The crusts formed are then ground for the ation is well known and has been studied particularly by our engineers.

The bulk of the water in these solutions is thus evaporated and only very concentrated solutions or sludges are allowed to pass out. These very strong hot liquors are finally dried out in a rotary dryer placed at the head of the lime-burning kiln, using its hot waste gases. The crusts formed are thrn ground for the market.

The concentrated solution before complete drying contains a small proportion of sodium chloride, corresponding in amount to the proportion of Na_2O in the original feldspar. On a spar running 10 per cent. K_2O the Na_2O content has averaged from 1½ to 2 per cent. This would give from the liquors completely dried at once, without any fractional separation of the NaCl, a product having about the following composition: KCl, 70 to 80 per cent.; NaCl, 14 to 16 per cent., and the balance a very small amount of lime salt and moisture. It is thus seen that without any attempt at fractional separation, muriate of potash, equal in character to the usual imported muriates, may be made from American feldspars.

If the hot concentrated liquors are not at once brought to dryness, but are given a fractional crystallization treatment, which may be made a continuous operation, whereby most of the NaCl is removed, the KCl crystals then obtained will run pure enough to enable their direct use in the manufacture of chemicals of a high grade of purity.

The plant required is equipped in a general way similarly to a Portland cement mill. There must be rock hoists, trackage, crushers, rolls, rock dryers, grinding mills, a rotary lime burner, the "clumpers" and rotary kilns, coal dryer and grinder, besides bins, elevators and conveyors, also leaching vats, tanks for strong liquors and for wash water, pumps, flue arrangements at stack for spraying the liquors, dryers and pulverizer, also air compressor and general power plant, stairs, ladders, handrails and buildings to house the plant.

Zacatecas.

In summer the all-day ride from Torreon to Zacatecas is hot, dusty and uninteresting as the train slowly climbs to Zacatecas, the highest point on the Mexican Central between El Paso and Mexico City. At present Zacatecas is one of the most backward of the famous camps of Mexico.

Scattered through the camp are old ruined "haciendas de beneficio" and surmounting the shafts are the horse "malacates," well named the "malacate de sangre" (the blood-power hoist) in contradistinction to the "malacate de vapor" (the steam hoist). The dumps scattered over the district, the idle "malacates," and the dismantled "patios" are indicative of conditions at Zacatecas. As if representative of the last throes of that magnificant past, a few years ago some ore from the Veta Grande mine was treated by the patio process, and "malacates," the exact reproduction of these hoists which Agricola pictured 350 years ago, are in operation at the Parroquia where "gambucinos" are hoisting ore in bull hides from a depth of 192 meters.

To the stranger the crudity of hoisting with a "malacate" is appalling. A horse whim is a luxury compared to a "malacate," and when one thinks of the deep mines that the Mexicans worked by means of these, such as the Valenciana and others on the Veta Madre at Guanajuato, the Viscaina and others at Pachuca, and still others elsewhere in Mexico, and remembers that some of these mines were very wet, he would have been able to stick to such methods so long.

As used at Zacatecas, the headframes are low and no bucket or rawhide sack is used for hoisting, but instead the ore is laced up in a bull hide. This load is landed on a plataform at surface and there unlaced, the ore being raked off into wheelbarrow.

History of the Camp.

Zacatecas is one of the oldest silver camps in Mexico for, as ore was found in 1546 at the San Bernabe mine, by Juan de Tolosa, it is several years older than Guanajuato. Soon afterward ore was discovered at the Veta Grande and the Quebradillas, the workings of which extend under the Alameda, one of the beautiful parks of Zacatecas. The camp flourished for in 1585 the town of Zacatecas, which had been founded in 1548, was raised to the rank of a city by the King of Spain. In the early days the camp was a large producer and, at the time of Humboldt's visit to Zacatecas, in the early part of the nineteenth century, the production was estimated by him to be from 300,000 to 400,000 "marcos" (1 marco = about 8 oz.) of silver per year, and he states that from 1785 to 1798 the king's fifth amounted to 1,204,721 "marcos."

During the time Mexico was passing through the wars that led up to its independence, the production was large when the mines were working, but this production fell off greatly whenever either army was in the vicinity; by 1875 the production was declining. In 1889, the smelters entered the market for silicious ores offering a cheap rate and settling immediately for 95 per cent, of the silver content of the ore. As the extraction by the "patio" process, owing to the basenes of the ore, had dropped to 65 per cent., Zacatecas miners gladly abandoned it. A little later there was a drought which lasted several years, so that the death of much of the stock and the higher cost of fodder caused the abandonment of what few "patios" continued to run. Many of the mines, owing to the higher cost of mining, were forced to shut down and later, when the smelter raised the rates on silicious ores, more mines were allowed to fill with water. A few of the mines continued to work, shipping their ore to the smelter. The El Bote company erected a pan-amalgamation mill to treat its lower-grade ore, and has thus been able to continue to the present its unbroken series of dividends during a period of over 60 years.

For the last 20 years most of the mines and "patios" have been shut down so that the production from the district has been small, coming from only a few mines; the last "patio" that treated custom ores was the Florida "hacienda." With the decline of local beneficiating, Zacatecas has declined so that now the district which once boasted 70,000 can scarcely find 25,000 inhabitants.

Geology of the District.

The Zacatecas district is composed of rounded ridges, rising 1000 to 1500 ft. above the surrounding country, which connect on the west with the foothills of the Sierra Madre range.

The main rock of the district is a diorite which in places is capped by a later rhyolite. To the west of town are slates, the oldest rock of the district, which in some places have been altered by intrusions, especially near the contact with the later diorite, so that they are quite schistose in character. Near the town occurs a reddish rock called by Burkart a conglomerate, but which is probably an agglomerate as it is said to resemble the agglomerate of Guanajuato.

The veins have a northwest-north-easterly strike and dip generally to the southwest at a high angle, but the Mala Noche vein system and the Parroquia-Magistral vein are notable exceptions to this statement.

The Main Vein Systems.

There are three main vein systems in the district, the Cantera, the Mala Noche and the Veta Grande. The Cantera, which is the most southerly of the three, is the largest and longest vein in the camp. On the east end this vein, which starts near Guadalupe, follows the contact between the diorite and the so-called red conglomerate; but to the west it cuts through the diorite and in the Bote property passes into the slates, being conformable with them in dip. The Cantera is on its western end more a vein system than a vein, for there are many branches.

South of town are the Veta de San Rafael and the Veta de los Campos, which appear to be especially strong spurs from the Cantera system, and to the northward is the Magistral-Parroquia vein, which also appears to be a branch of the Cantera system.

The ore from the Cantera system is characteristicafly silicious and quite free from sulphides other than those of silver. In the zone of oxidation the silver occurs as a bromide, iodide or chloride and also native, but below this zone argentite is the most important silver mineral, although in some parts of the vein much ruby silver is found. In the Magistral-Parroquia vein, although apparently it belongs to the same zone of fissuring, the ore is a silicious silver-copper ore in which chalcopirite and pyrite are the chief metal-bearing minerals.

The Mala Noche vein, to the north of the Cantera, differs radically from the other veins in the district, and the ore appears most closely related with the Magistral-Parroquia ore; in fact, some copper ore is found in a small separate vein in the San Roberto mine. The strike of the Mala Noche is east and west and the dip is toward the north instead of toward the south. The ore carried a great deal of pyrite; but no copper; the pyrite content varies considerably along the vein, for on the west end, in the San Roberto mine, the ore has an excess of iron over silica, while in the San Bernabe on the eastern end where the vein is in the diorite, the ore is silicious, but carries 20 per cent. iron. On the east end the vein splits into several small veins, but to the west it strengthens and unites so that in the San Roberto mine, where the vein follows the contact between the diorite and the slate, present development shows a width of 100 feet; beyond the San Roberto the vein passes out of the diorite and in the Zaragoza is entirely in the slate.

To the north of the Mala Noche vein is the Veta Grande system of fissuring. The veins of this system have a north-west-southeast strike and dip at a high angle to the southwest. The ore in the Veta Grande vein system is a silicious silver ore resembling the ore mined from the Cantera vein. The Veta Grande mine, which has been one of the largest silver producers in the Republic, is the chief mine on this lode, but there have also been several other smaller producers and at present to the west of the Veta Grande mine some virgin ground on the same lode is being developed.

Besides these three main veins, there are others less well-devoloped, especially the Veta de Tajos and the Vetas del Oritas. The Veta de Tajos is a silver-producing lode to the north of the Veta Grande and near the town of Pánuco, while the Vetas del Oritas are gold-bearing lodes south of Zacatecas.

There are also a series of barren cross veins, which cross the Cantera vein, and it is at these points of crossing that the richer orebodies of the system are found; but it is said that at the Veta Grande mine no such characteristic enrichment was noticed.

Developments at Depth.

The zone of oxidation in the district extends to a depth of 150 ft., and at a depth of from 480 to 500 ft., a barren zone occurs in many, if not all, of the veins. The finding of this barren zone at several of these mines has discouraged deep development, but the fact is that very little is known about the veins in depth at Zacatecas, for although the Mexicans worked to considerable depth at Guanajuato, at Zacatecas the mining was done mostly above a depth of 500 ft. The deepest shaft in the district is at the San Rafael mine, the Lete shaft being 240 m. deep, but practically all of the development in that mine has been done above that depth. As the shaft is sunk along a barren part of the vein, the ore has not been developed by the small amount of work done on the deepest level of the mine. The Bote mine is 1000 ft. deep and most of the ore developed above that level has been mined.

The Veta Grande is developed to a depth of 365 m., and there, while fewer bonanzas are found on the lower levels than near surface, the ore is said to be more uniform in character and of good grade.

Mexican Scenes.

Mexican Scenes.

Making Drawnwork, Aguascalientes.

The Curb Fruit Stand.

Transportatión in Tepic.

The Tortilla Maker.

Village in Sinaloa.

A Mexica Brazero.

Piz-Piz District of Nicaragua.

An important gold-mining district has been developed in eastern Nicaragua, and numerous milling and electric-power plants are being installed. The region first became known in 1893 when the Siempre Viva mine was examined by Courtenay De Kalb in the interest of W. R. Grace & Co., of New York. The report was favorable, but difficulties with the original owners of the property led to the abandonment of the enterprise by W. R. Grace & Co. The mine was worked in a feeble way the owners, and finally fell into the hands of Samuel Weil of Bluefields. Today it is operated by the Siempre Viva Mining Co., dominated by William Adler, of New Orleans. A 20-stamp mill has been erected, with a disentegrator for soft ore, and a small cyanide plant has been placed in commission. The company treats 2500 tons of ore per month, said to average $9 per ton. The mill is being enlarged and electric haulage is being introduced in the mine.

The Siempre Viva vein is of great longitudinal extent, being covered by three claims revealing over 4000 ft. of continous lode with remarkably uniform gold content. The strike of the vein is northeast, the Concordia mine lying southwest and the Constancia northeast of the Siempre Viva. At the Concordia are 10 stamps and a disintegrator, and at the Constancia is also a 10-stamp mill, to which 10 more stamps will be added immediately, and plans for fine grinding for amalgamation are also being made. This property is owned by the Concordia Gold Mines Co., of New York.

The great gold belt of the region, locally called the Veta Madre, parallels the Siempre Viva vein on the southeast side, and extends across country for eight miles. The largest plant of the district is at Lone Star mine, on the Veta Madre. Here are installed 30 stamps with cyanide equipment. The deposit is from 50 to 150 ft. wide, and the ore is extracted at insignificant cost by quarrying. The mill treats 3000 tons per month of hard quartz ore averaging $6.50 per ton in gold.

Farther northeast on the same lode is the Mars mine, yielding similar ore, which is treated in two Huntington mills, 3½ ft. diam.

A 75-kw., 2300-volt, electric-power plant has been installed at the great falls on the Piz-piz river, where 15,000 hp. can be developed at any time. An electric plant at the Siempre Viva falls, where 10,000 hp. is available, has for a considerable period supplied power to several mines in the district. On a cross-lode south of the Mars is the Bonanza mine. Here 4000 tons of ore per month are treated in 8 Huntington mills. This plant has a cyanide installation, including leaching tanks and equipment for slime treatment by decantation.

The high-grade mine of the region is the Josefina, where a $150 ore is being treated in two 3-stamp prospector's mills. The vein is from 2 to 3 ft. wide, the pay-streak being sorted out, and $10 ore being stored on the dump for future treatment. About a mile and a half south from the Siempre Viva, on the watershed of the Banbana river, are the Rosa Lee and Colorado mines, owned and operated by N. J. Martin, of Cape Gracias a Dios, Nicaragua. He has erected an electric transmission line 8000 ft. long, drawing power from the Siempre Viva plant. The equipment on the property consists of a 5-stamp mill at the Colorado mine, and a 3½-ft. Huntington mill at the Rosa Lee.

This mining district lies at the headwaters of the Piz-piz river, an affluent of the Wanks, which important stream empties into the Caribbean sea at Cape Gracias a Dios. The gold belt also extends over the divide into the watershed of the Banbana river, which empties into the Principulca. The latter reaches the Caribbean at the town of the same name in what was until recently the protectoarte of Mosquita, better known as the Mosquito Coast. By river the Piz-piz gold district is nearly 250 miles from Principulca, but the distance in an air-line will not exceed 80 miles. A mineral belt extends along the foothills of the mountains all the way from the Wanks to the Escondido river, 90 miles southward, and valuable mines have been found at Cuicuina on the Principulca river, 20 miles or more from the Siempre Viva mine, and at Walpatara on the Banbana. The Santa Rita mine at the Walpatara rapids was originally opened and successfully worked by W. D. Parker, for gold. It was bougth by New York people, and the Santa Rita Mining & Exploration Co. was organized. Development soon revealed a copper vein 30 ft. wide, from which shipping ore of extraordinary grade has been taken.

Near the Santa Rita, four miles from Tunkey, is El Golfo mine, the property of José Arámburo, where a plant containing two 5-ft. Huntington mills is in operation. A tramway 5 miles long has been built from the mine to the Banbana rier. At Cuicuina, the La Luz y Los Angeles mine is being opened on a large scale. A mill is being erected consisting of six 5-ft. Huntington mills and a cyanide plant. Gold in this district was originally discovered at Cuicuina in placers, and exploited by Schultz & Son, of Wunta Plantation; some pocket mines in the vecinity have also yielded large sums erratically.

Gold has been reported from the Wawa and the Grand rivers, but no large deposits have as yet been proved; the Topaz mines at Rama on the Escondido river, however, have been shipping large amounts of bullion for several year. This property is remarkably situated, being within two miles of tide-water on the river, and only four miles from Rama, at which point fruit steamers from New Orleans touch several times each month. The plant operating at the Topaz mine consists of 20 stamps with a well equipped cyanide annex.

One per cent of the contents of the oceans would cover all the land areas of the globe to a depth of 290 feet.

The value of all the gold produced in the United States from 1792 to January 1, 1914, is estimated by the United States Geological Survey at $3,549,799,400; the value of the silver at $1,709,517,600.

In South Africa there is a standing committee to look into the question of safety catches for mine hoisting shafts. It has been stated that the mines are not in favor of safety catches, but the South African Mining Journal remarks that this is only an exemplification of a perfectly legitimate attitude, that pending a really reliable device the best safety catch is a good rope.

The work of the smelter chemist is usually organized for speed and not for extreme accuracy. When a single operator handles a hundred estimations per day, his figures in his reports on silica, iron and lime beyond the tenth of per cent mark can not be expected to signify much. Yet in the long run his work will compare favorably with estimations made in a scientific laboratory where processes taking a week are employed.

The Chilean government is feeding 60,000 nitrate workers who have been thrown out of employment and whose condition is desperate.

Domestic Pebbles to Replace Foreign Supply.

The European war has threatened to disturb the importation of flint pebbles, upon which, during recent years, cement manufacture and gold-ore milling have been dependent in large measure. The Geological Survey, in Bulletin 599, "Our Mineral Reserves," recently suggested some sources of domestic flint and other pebbles that are avaliable as substitutes for foreign flints. Since the issue of that bulletin other sources and other substitutes have attracted attention. Besides the flint gravels of the Gulf States and the beach gravels of New England, which are mentioned in Bulletin 599, there are also available suitable gravel deposits on parts of the shores of Lake Superior and the Pacific coast and, particularly in the Western States, stream gravels containing tough and resistant pebbles of granitic, rhyolitic, and basaltic rock. Furthermore, mill tests have demonstrated the efficiency of artificial pebbles, made by rounding quarried blocks of rhyolite in a tumbler. Roughly cubical or angular talus blocks of basalt, taken as they are found, also become well rounded during use. It has also been suggested that tough and blocky gold ores can be made to supply of themselves pebbles for grinding.

New Publications.

Working Data for Irrigation Engineers. By E. A. Moritz, Engineer U. S. Reclamation Service. 408 pages, 6x9, illustrated, including many full page diagrams, many tables, cloth, Price $4.00. John Wiley & Sons, 432 Fourth Ave., New York City.

Masonry. A short text book on masonry construction, including descriptions of the material used, their preparation and arrangement in structures. By Malverd A.. Howe. 6x9, 169 pages, 115 figures, cloth. Price $1.50 John Willey & Sons, New York.

The United States Geological Survey has just published as Bulletin 580-P a bibliography, compiled by Isabel P. Evans, of publications by Survey authors on metals and nonmetals, except fuels. This bibilography is a revision, enlargement, and continuation to date of the bibliographic lists on similar subjects previously published by the Survey. It is compiled mainly from publications of the Geological Survey, but cites also articles by Survey authors which have appeared in other publications. A copy of Bulletin 580-P may be obtained free on application to the Director of the United States Geological Survey. Washington, D. C.

Design of Steel Bridges. By. F. C. Kunz. 472 pages. 6x9. Fully illustrated A very comprehensive and practical book, giving in compact form for ready reference all the essential data needed by the engineer, designer and student. The text and the methods of calculation, both graphic and algebraic have been condensed and fully cross-referenced to the tables and plates to make every part accessible. McGraw-Hill Book Co., 239 West 39 St., New York. Price $5.00.

Handbook of Milling Details. Compiled from the Engineering and Mining Journal by the Editorial Staff. New York· McGraw-Hill Book Co. Pp. 425; illustrated. $4.

This book is a collection of articles by various authors that have appeared in the Engineering and Mining Journal during the last 2 or 3 years under the general head of "Details of Metallurgical Practice." In compiling this book good judgement has been shown in the selection of the articles. In arranging the articles convenience of reference has been facilitated by grouping them in chapters under the general subject treated. There are eight chapters on the following subjects: Sampling. Ore Dressing—Breaking, Crushing, Grinding. Ore Dressing—Washing, Separating and Concentrating. Accessory Apparatus for Ore Dressing. Notes on Equipment of Metallurgical Plants. Hydrometallurgical Processes. Smelting. Refining.

Specific Heat of Copper in the Interval 0° to 50° C., With a Note on Vacuum-Jacketed Calorimeters. By D. R. Harper. Washington, D. C.: U. S. Bureau of Standards, Department of Commerce. Scientific Paper No. 231; pp. 65; illustrated.

Copper Wire Tables. Washington, D C.; U. S. Bureau of Standards. Circular 31, Third Edition; pp. 76.

This circular, with its tables, is of interest chiefly to electrical engineers. The tables are based on the internationad standard values for the resistivity, temperature coefficient, and density of copper, as defined by the International Electrochemical Commission.

The Manufacture of Acid Phosphate. By Wm. H. Waggaman Washington, D. C.: U. S. Department of Agriculture, Bureau of Soils; Bulletin No. 144; pp 28; illustrated.

Describes the manufacture of acid phosphate from phosphate rock, detailing the chemical and mechanical changes involved. Of interest to fertilizer manufacturers generally.

Memoirs of Henry Forbes Julian. By Hester Julian. Philadelphia: J. B. Lippincott Co. Pp. 311; illustrated. $2.50.

This work will be of personal interest to friends and acquaintances of Mr. Julian, one of the heroic victims of the Titanic disaster. Others will also find much of interest and value in these memoirs of a metallurgical engineer of international reputation.

The Iron Ores of Lake Superior, Second Edition. By. Crowell & Murray. Cleveland, O.: Penton Publishing Co. Pp. 263; illustrated. $3.50.

This book is a compilation of varied and useful information relating to the iron ores of the Lake Superior region. This material has been taken from various sources, but most of it has appeared in the various trade journals, geological reports, and scientific-society transactions. Late descriptions are given of the mines on the different ranges and data added concerning their location, and names of managers, superintendents and sales agents. There are 10 chapters on the following subjects: The Early History of the Region. Geology Mineralogy. Production of Ore. Dock Equipment. Classification of Ores. Beneficiation of Ores. Methods of Analysis. Fuel Engineering. Location and Description of Mines. In addition there are a number of original maps of the ranges.

Thirteenth Biennial Report of the Bureau of Mines of the State of Colorado for the Years 1913 and 1914. By T. R. Henahan. Denver, Colo.: Bureau of Mines of the State of Colorado. Report; pp. 288; illustrated.

Contains a large amount of diversified information concerning the mining industry of Colorado.

The Mineral Industry of New Jersey for 1913. By M. W. Twitchell. Trenton, N. J.; Geological Survey of New Jersey. Bulletin 15; pp. 46.

Reviews the production of zinc, iron, clay and clay products, stone, sand and gravel, Portland cement, lime, sand-lime brick, mineral waters, mineral paints, coke and by-products, greensand marl, and peat, together with a review of the mineral industries of the counties.

Economic Minerals and Mining Industries of Canada. Ottawa, Ontario, Canada; Canada Department of Mines, Mines Branch. Pp. 78; illustrated.

This pamphlet has been compiled with the object of presenting in a popular form a brief sketch of the more important economic minearls, and of the mining and metallurgical industries of Canada. This is a special edition prepared for the Panama-Pacific Exposition at San Francisco.

United States Coals Available for Export Trade. By Van H. Manning. Washington, D. C.; U. S. Bureau of Mines. Bulletin 76; pp. 15; illustrated.

The purpose of this bulletin is to describe briefly the general character and commercial quality of some of the coals mined in the United States that reach tidewater shipping ports, and to show in a general way the important characteristics of those coals that, by reason of transportation facilities and the situation of the coal fields, are most available for export.

PATIO.

A mill for the recovery of platinum is in operation in Wyoming. The process employed is one of concentration, the ore being ground to 60-mesh in a Hardinge pebble mill and the pulp run through a Peck horizontal centrifugal concentrator. In the early operation of the mill acidity of the mill water gave considerable trouble. Some of the copper in the ore occurs as sulphate and other soluble forms. The mill water becoming impregnated with copper salts corroded screens and other metal work throughout the mill. To neutralize this acidity lime to the amount of five or six pounds per ton is added in the crushing department.

In copper converter practice the basic lined vessel is rapidly displacing the acid lined shell, and size of the converter is being increased proportional to the capacity required. The largest converter to date is that at Great Falls which is of the vertical type and has an inside diameter of 20 feet. The vertical type is preferred at most of the large smelters, the objection to the horizontal cylindrical type being the necessity for numerous openings in the large sizes for the introduction of siliceous material. In large, horizontal converters it is also difficult to get uniform temperature and uniform action throughout the charge. All recent converters are operated electrically instead of by hydraulic mechanism.

A company has been formed in New York for the manufacture of metallic magnesium. Work has been started in Virginia on a plant to turn out ten tons of the metal monthly.

It is characteristic of many Cripple Creek ores that a simple mechanical concentration can be effected by merely crushing and screening, saving the finer and rejecting the coarser portions. The net profit per ton is not great, but amounts to considerable on a large tonnage. The Vindicator Consolidated mill was designed and built to take advantage of this condition. The cost of the mill is small as compared with the concentrating and cyaniding mills employed in the district. Ores of too low grade to be treated by a more elaborate process are milled, and the product is shipped to the smelters.

Synthetic crude oil is the subject of a recent patent and is attracting considerable attention. The invention rests upon the discovery that when any hydrocarbon is placed in a closed vessel of such dimensions that the hydrocarbon occupies about three elevenths of the enclosed space, and that when the vessel is heated under these conditions to such a temperature that the vapor pressure rises to about 800 lb. per sq. in. the substance in the vessel is converted into a material in every respect similar to crude oil.

It seems that any product of oil refining may be converted in this way, and after conversion made to yield the usual amount of a good grade of gasoline, and the residues may be subjected to further conversions. Still residue, the very heavy residue left after petroleum refining, has been made to yield an additional 55 per cent of a colorless, high grade gasoline. From gas oil 60 per cent of gasoline has been made, and from paraffin 65 per cent. It is not yet known whether the process can be used in practical oil refining, because the pressure of 800 lb. is rather high for practical purposes. A small amount of a catalytic agent is used to affect the conversion. Some 2000 experiments with the process were made by the Milliken Refining Co. St. Louis, Mo.

The Merrill Metallurgical Co. has acquired the Clevenger patent for the use of a brittle alloy for precipitating gold and silver from cyanide solutions. The alloy consists of zinc with about three per cent. of metallic sodium. This alloy is brittle and can be powdered and in this form used for precipitation in the ordinary way.

A mill in Colorado concentrates the ore by simply crushing and screening, the finer sizes being rich enough to ship to the smelters and the oversize being sent to the dump. The material passes through several stages of crushing, screening and washing. The plant has a capacity of 400 tons per day and cost in round numbers, $34,000.

In using coal-dust firing there are certain conditions which can not be neglected if the best results are to be obtained. The coal must be dry, no more than one per cent moisture being permissable. The coal must be finely pulverized, At Anaconda the grinding is done so that from 93 to 97 per cent will pass 100-mesh, and from 79 to 82 per cent through 200-mesh. The delivery of the coal and air into the furnace must be controlled so that the proper proportion of each may be secured. An excess of air cools the furnace and too little air involves incomplete combustion. The coal must contain enough volatile matter to maintain proper combustion. In cement kilns coal with volatile matter as low as 20 per cent is used, but among steel men 30 per cent is demanded as the minimum. The furnace must be properly proportioned and equipped, and provision must be made to dispose of the ash. This latter point is not important in coal dust firing as applied to reverberatory practice for the ash promptly melts into the slag of the charge.

An improved form of copper converter has been patented by Herbert Haas. The new Haas converter has for its object the conversion of matte into blister copper continuously instead of intermittently as in present methods. The coverter consists of a shell lined with magnesia brick. The bottom comprises a central bell or inverted cone portion and a depressed annular portion. In the center of the cone is the tuyere block, the blast openings being directed upward, outward and in a tangential direction. A tap hole is placed at the level of the annular portion of the bottom for the removal of molten copper and an upper tap hole for the removal of slag. The tuyeres are in greater number than in ordinary converters, but of smaller cross-section. The function of the depressed, annular botton is to store the copper which has been converted and to remove it from the action of the blast.

A new method for the recovery of uranium, vanadium and radium from carnotite ores is the subject of a recent patent. The ore is ground to about 1100 deg. F. for about an hour. ing atmosphere at a temperature of about 1100 deg. For about an hour. Sulphuric acid is then added; this dissolves about 90 per cent of the vanadium and all the uranium, and converts the barium and radium into insoluble sulphates which remain in the residue. The soluble vanadium and urainum are removed by washing and filtering, and the washed residue treated with caustic soda and sodium carbonate which converts the radium and the barium into carbonates. The residue which still contains the radium and barium are again washed and then treated with hydrochloric acid which dissolves the radium and barium. The solution is removed and precipitated with sulphuric acid, the sulphates separated and again converted into choloride after which the radium salt is concentrated by crystallization.

At the Timber Butte mill Wilfley tables are made to handle 100 tons of material per day, each by a modification of the form and distribution of the riffles. These tables take the undersize from impact screens without previous classification, and not only handle an unusual tonnage but make in one operation a coarse zinc concentrate containing from 49 to 51 per cent zinc and not more than 4 per cent insoluble. They also send all the fines from the mines and those made by preceding crushing operations to two Akins classifiers to be separated from the tailings and passed on to the flotation machines. With the exception of this roughing operation of the Wilfleys, the only other gravity separation of mineral is performed on James tables which treat the coarse portion from the flotation machines. All other concentration in the mill is by means of flotation. The capacity of the mill is 450 tons per 24 hours. The ratio of concentration for zinc is three to one, and for lead-copper-iron concentrate 125 to one. Extraction averages about 76 per cent for the zinc and 92.6 for the silver.

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ASK FOR CATALOGUE.

PERSONALS.

C. H. Munro has gone to Colombia.

G. J. Kapteyn has gone to Colombia as superintendent of the cyanide mill of the Bar Principal Mining Co.

A. E. Drucker has gone to Colombia to build a cyanide mill for the Frontino & Bolivia Gold Mining Co.

Chas. S. Witherill is general superintendent of the reduction plant of the Chile Exploration Co. L. M. Green is in charge of leaching, with M. R. Thompson in charge of the electrolytic tank house and Otto Koch in charge of smelting and smelting.

C. G. Priest has left London for Honduras.

F. P. Lacy has returned to London from Mexico.

The firm of Ricketts & Banks, of New York, has been dissolved by mutual agreement. The address of Dr. Rickertts is 80 Maiden Lane and that of Dr. Banks, 61 Broadway, New York.

S. F. Shaw has changed from Charcas, S.L.P., to El Paso. His address is Marguerite Apartments, Octavia and Boulevard Streets.

Burr J. French is with the Cinco Minas company at Magdalena, Jal.

Joseph Inch is with the Cia de Minas de Cobre de Gatico, Gatico, Chile.

D. C. Livingstone, formerly of Sonora, is professor of mining engineering at the University of Idaho, Moscow, Idaho.

Jas. H. Smith Jr., is with the Cerro de Pasco company, in Peru.

Wm. B. Boggs, formerly at Parral, Chih., is assistant to the Head of the Smelting Department of the Nichols Copper Co., Laurel Hill, New York.

J. T. K. Crossfield is surveyor for the Chile Exploration Co., Chuquicamata, Chile.

Chas. A. Fellencer, Barranquilla, Colombia, is engineer for the Colombia Explotation Syndicate.

Fredk. B. Forbes is assistant superintendent of the Escandalo mine at Granada, Nicaragua.

Frank L. Stack is chemist and assayer for the Chile Exploration Co., at Chuquicamata, Chile.

J .R. Ambrosis' address is Apartado 1343, Mexico, City.

Walter M. Brodie is at 50 Broad St., New York City.

Wm. N. Fink is with the Cusi Mexicana Mining Co., Cusihuiriachic, Chih.

Alexander Grosberg is with the Simon I. Patino Tin Mines, Uncia, Bolivia.

Jas. W. Hambleton is with the Torreon Smelter, Torreon, Coah.

G. H. Carnahan is with the Teziutlan Copper Co., 82 Beaver St., New York.

P. K. Lucke is general superintendent of mines for the Penoles company, Mapimi, Dgo.

Geo. B. Marshall is with the La Union Mine, Miramar, Costa Rica.

H. H. Miller has been appointed manager for the Cia. A. Minera Lo Inercible at its mines in El Callao district, Venezuela.

C. Q. Schlereth has returned from the States and is with the Penoles company at La Ojuela, Dgo.

H. A. Kruger has returned from Los Angeles, Calif.

John B. Carman is again with the A. S. & R. Co., at Velardena, Dgo.

A. M. Yonge has returned to Costa Rica from a visit to the States.

A. H. Wickham is in Tepic.

W. H. Knowles, of Sonora, is in the States.

C. A. Rodegerdts has arrived in Mazatlan from the States.

H. C. Enos was married in Salt Lake City to Miss Caroline Nolan. His address is Hotel Paso del Norte, El Paso, Texas.

Newton C. Marshall has joined the engineering force of the General Development Co., Buena Ventura, Colombia.

J. T. Keating has gone to the Argentine.

A. N. Mackey is in Colombia.

W. A. Pritchard has returned to Colombia from Europe and the States.

F. W. Thomas is manager for the Babilonia property in Nicaragua.

H. E. West has joined the Charles Butters' engineering staff at Oakland, Calif.

Albert E. Bruce is metallurgist with W. R. Grace & Co., La Paz, Bolivia.

E. V. Burnett is with the Soc. Francaise des Minas de Cuivre de Collahuasi La Grande, via Antofagasta, Chile.

G .J. Sielaff, mining engineer, is at Abangarez, Costa Rica.

Jas. S. Worth is with the Chile Exploration Co., Chile.

Edwin B. Nagle is general superintendent of the Cuba Copper Co., Santiago, Cuba.

Francis J. Strachan is with the Cananea Consolidated Copper Co., Cananea Son.

Timothy D. Walsh, formerly of Chihuahua, is now in Denver.

John M. Brooks, Jr., is with the Buena Tierra mine, at Santa Eulalia, Chih.

Stanley C. Herold is with the Cartagena Oil Refining Co., Cartagena, Colombia.

Scovill E. Hollister is mill superintendent for the Cia. Estanifera de Llallagua, Llallagua, Bolivia.

L. W. Kemp is with the Chile Exploration Co., Chile.

E. Fleming L'Engle is superintendent of the Aguacate mines, San Mateo, Costa Rica.

H. A. Lewis is now at Potosi, Bolivia.

TRADE NOTES

Charles Mundt & Son, 53 Fairmount Ave., Jersey City, N. J. Catalogue of 64 pages illustrates and gives specification of a few of the many perforations of perforated metal sheets made. The company makes perforated screen plates and sheets for ores, stone, gravel, cement, etc., also perforated steel floors and anything in perforated metal.

Goulds Mfg. Co., Senece Falls, N. Y.: A two page illustrated descriptive sheet presents three illustrations of a new line of multi-stage centrifugal pumps that the Goulds company is now placing on the market. These show a 3-stage pump with top half of casing raised to show accessibility of interior; a 3-stage pump direct connected to electric motor; and a 3-stage pump with top half raised to show that the bearing can be removed without disturbing the pump shaft.

Bartlett & Snow Co., Cleveland, Ohio: Bulletin No. 43, 10 pages, illustrated, treats of the "Cobasco" system for handling materials. It is entirely automatic in its operation as far as the operation of the skip bucket is concerned. The system is being used for the handling of various classes of material such as ore, coal, ashes, limestone, coke and cilinder. It is adapted generally the handling of materials of an abrasive nature.

Woodin & Little Pump House. 33 Fremont St., San Francisco, Calif.: Catalogue N. 36, 252 pages, illustrated, covers a wide range of power apparatus and equipment for handling water under many different conditions. Among the pumps and sinking pumps, as well as pumps for irrigation and other purposes. It also presents a line of horizontal and vertical gasoline and distillate engines, hoisting apparatus, water supply systems, etc.

Redwood Manufacturers Co.; The San Francisco offices of this company have been moved to 1618 Hobert Bldg.

Denver Quartz Mill Co., Denver, Colo.: The company has recently received a rush order for a 50-ton Denver quartz mill and an Isbell concentrator to be used on zinc ore from the West Kentucky Ore Co., Marion, Ky.

Chain Belt Co., Milwaukee, Wis.: Catalogue No. 56, 303 pages, illustrated is a servicable reference book of the products manufactured by the Chain Belt Co. It deals with elevating and conveying machinery, chain belt, sprocket wheels, transmission machinery, etc., for saw mills, power plants, and various other lines of industry. Two chain belts particularly featured are the "Griplock" (malleable) and "Chabelco" (all-steel). The catalogue is copiously illustrated, the illustrations showing the various productos and many installations of them. The volume is bound in hard cloth covers for permenant reference.

P. H. & F. M. Roots Co., Connersville, Ind. Catalog 42, Roots Blowers, 47 pp., illus., 7½×10 in. This catalog describes the Root line of blowers for smelting furnaces; contains charts and data, also views of the installations at the plants of the British Columbia Copper Co., Anaconda Copper Mining Co., United Verde Copper Co., and the U. S. Smelting Co. Catalog 46, Foundry Blowers, 47 pp., illus., 7½×10 in. Some blowers shown in this catalog may be used for mine ventilation, and are capable of operating against pressures varying from ½ lb. to 10 lb. per sq. in., but the company builds blowers of any desired capacity, some of the largest having a displacement of 400 cu., ft. per revolution. The machines shown are of the positive pressure type. Catalogue 48, Vacuum Pumps, 16 pp., illus., 6×9 in. These pumps have recently been found to be of use in connection with filtration in cyanide plants. Catalog 47, General Catalog, 16 pp., illus., 6×9 in. In a condensed manner gives the full line of blowers, pumps and exhausters made by the Roots company.

Parral Tank System of Agitation, I. W. Hellman Bldg., Los Angeles, Calif. An illustrated 4 page folder describes the use of the Parral tank for the leaching of copper ores and flue dust in acid solutions, and the concentration of copper sulphide ores by oil flotation.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	28.553
February	59.043	61 642	57 506	27.190	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59 207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58 175	28.038	27.825	26.704
June	61.290	58 990	58.471	28.215	27.198	26.948
July	60.854	58.721	54 .878	27.818	27.074	25.218
August	61.808	58.263	54 .344	28.375	27.335	25.878
September	63.078	60 .840	53 280	29.088	27.886	24.280
October	63.471	60 .763	50 .854	29.299	28.083	23.189
November	62.782	58 .985	48 .082	28.012	27.283	22.703
December	63,385	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14.872	61.603	14.871	.....	67.140	66.274
July	14.190	13.223	14.563	.....	64.188	64.955
August	15.400	.....	15.804	.....	68.200	53.227
September	16.328	.....	16.788	.....	73.125	.....
October	16.337	.....	16.913	.....	73.363	.....
November	15.182	11.739	16.022	.....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1913	1914	1913	1914
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.555
March	46.832	38.038	213.615	173.810
April	49.115	36.154	224.159	163 963
May	49.038	33.360	224.143	150.702
June	44.820	30.577	207.208	138.321
July	40.260	31.707	183.511	142.517
August	41.582	.. ..	188.731	.....
September	42.410	32. 675	193.074	.....
October	40.462	30.284	184.837	.....
November	39.810	33.304	180.869	138.391
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound sterling per long ton.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.870	4.177	3.850	15.977	19.651
Apri	4.381	3.810	4.242	3.883	17.597	18.225
May	4.342	3 900	4.226	3.883	18.923	18 503
June	4.325	3.900	4.180	3 810	20.226	18.411
July	4 353	3.881	4 223	3.738	20.036	19.051
August	4.824	3.875	4.550	3.715	20.408	
September	4.898	3.828	4.578	3.658	20.648	
October	4.402	3.528	4.253	3.384	20.302	
November	4.283	3.883	4.148	3.585	18.334	18.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1931	1914
January	6.931	5.262	6.854	5.112	26.114 25.338	21.583
February	6.239	5.377	6.089	5.227	24.605	21.413
March	6.078	5.220	5.926	5.100	27.313	21.460
April	5.641	5.113	5.491	4.963	24.583	21.569
May	5.406	5.074	5.256	4.924	22.143	21.393
June	5.124	5.000	4.874	4.850	20.582	21.345
July	5.278	4.820	5.128	4.770	20.706	21,588
August	5.858	5.588	5.508	5.418	21.148	
September	5.884	5.380	5.444	4.230	20.814	
October	5.340	4.809	5.189	4.750	20.581	
November	5.228	5.112	5.063	4.882	21.214	25.016
December	5.156		.004			
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

AMERICAN SOCIETY OF MEXICO.

The Society of the American Colony of Mexico City has been reorganized on broader lines, under the name of "The American Society of Mexico."

At a mass meeting recently held in the City of Mexico a new Board of Directors was elected, together with the following named officers: President: R. M. Raymond; Vice President, Dr. Sidney Ulfelder; Secretary, J. D. Helm; and Treasurer S. S. Conger.

At a later meeting the Society adopted a new Constitution and By Laws, providing for permanent organization. This is broad in scope, to cover present and future needs.

The object of the Society as stated, is to promote the welfare of the American residents of the Republic of Mexico. Among other powers the Society is authorized to take cognizance of and act upon all subjects of general interest of its members; to promote and establish mutual cooperative relations; to cooperate with and assist other American institutions of Mexico; to provide, when expedient, a home or house for the accommodation of its members; and to acquire property when desirable for the uses of the Society.

All properly recommended nationals of the United States of America, either men or women residents of the Republic of Mexico, may become members of the Society by signing cards of registration.

The principal office of the Society is to be in the City of Mexico, but branch offices may be established elsewhere.

Heretofore the membership has been limited to men, but in the reorganization the women are invited to join. The present membership of about 1,300 will at once be largely increased.

A cordial invitation is extended to all Americans, men and women, throughout the Republic to identify themselves with this movement for mutual benefit. Naturally the Society will be non-political and non-sectarian. It is also entirely democratic and requires of applicants nothing more than a recommendation as to good character.

It is hoped that Americans of all occupations throughout the Republic will recognize the importance of such an organization and will identify themselves with it. If they do real benefits can be secured for all concerned.

There is need for a strong Society and better opportunities for acquaintance than have heretofere existed among the Americans so widely scattered over this great and undeveloped country. It is important that more and reliable information be had of the Americans living in Mexico, and that a common channel of communication be provided for various purposes. This will give an opportunity for united expression of sentiment and united action in matters relating to the common good. It will make possible a registration of American residents that has not existed heretofore.

When the plans are fully developed in the course of time the Society will be able to provide a Club or meeting place for Americans from all parts of the Republic when they visit the capital; meantime it can be made useful as a source of information to non-resident members.

All who feel an interest are invited to correspond with.

J. D. HELM, Secretary.
408 LA MUTUA, MEXICO, D. F.

Reeves Pully Co., Clinton & Monroe Sts., Chicago. Catalogue No. 7; 207 pages, gives general description and specifications of a line of modern appliances for the economic transmission of power.

Pittsburgh Tool Steel Wire Co., Monaca, Pa.: An 8 page pamphlet issued by the company gives tables of sizes, weights and prices of "Monaca" and "Champion" drill rods, cold-drawn alloy steel wire and rods, especially selected crucible steel wire, steel wire in coils or rods for springs, etc.

Ingersoll-Rand Co., 11 Broadway, New York. An illustrated 20 page bulletin describes a new type of air compressor manufactured by the Ingersoll Rand Co. The distinguishing feature of the air end is the Ingersoll-Rogler valve, which is discussed at some length. In addition some improvements have been made in the driving end. The class "ER-1" compressor is especially suited to the needs of the small shop, foundry and power plant.

Tate, Jones & Co., Inc., Empire Bldg., Pittsburgh, Pa. An illustrated 31 page catalogue calls attention to the economy of oil as a fuel, pointing out its economy for steam production and giving data from comparative tests for coal and oil. Also gives results with the use of oil with direct fired, reverberatory, regenerative and crucible furnaces and kilns. Describes the Tate-Jones fuel oil burners and the principe upon which they operate. In design they embody a combination of high and low pressure. The oil is fed to the burner at from 15 to 25 lbs. pressure and there atomized by a small quantity of compressed air (or steam under certain conditions) at a slightly lower pressure, after which an air blast of from 4 to 6 ozs. is used to supply the necessary amount of oxygen for complete combustion. Various styles of burners are illustrated and described. Several pages are devoted to systems for pumping, heating and regulating oil flow to burners.

The introduction of fused silica dishes has greatly affected chemical industry and especially the details of the manufacture of sulphuric acid. Acid is now concentrated in trays of pure silica, the trays being subjected to the direct heat of the fire. This material is not affected by any acid except hydrofluoric which is rarely present. Breakage of the trays does not exceed five per cent per annum.

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Como Aumentar las Utilidades en la Minería.

A continuación insertamos algunos consejos de un hombre práctico en la materia que de seguro serán de gran utilidad a los mineros.

Téngase el molino siempre trabajando y las estampas siempre en movimiento y no se interrumpa nunca su funcionamiento por cualquier insignificancia.

Enséñese a los operarios respectivos cómo cambiar las cribas en tres minutos y cómo aderezar las placas, si se insiste en el uso de la amalgamación, en diez minutos.

Enséñese a los operarios a ajustar una de las piezas de una estampa con las otras cuatro estampas funcionando.

Enséñese a los operarios cómo deben alimentar las estampas de manera que éstas al rebotar no machaquen en hierro frío.

Enséñeseles a conservar siempre lubricadas las chumaceras de la máquina y partes que lo necesiten, evitando que estos echen grasa en los morteros o en las placas.

Enséñeseles a hacer todo género de reparaciones sin interrumpir el funcionamiento del molino.

Enséñeseles a que las concentradoras den su rendimiento normal; pero no tratar de obtenerlo con una pulgada de pasta en ellos.

Enséñeseles a llevar la cuenta del tiempo perdido por las diferentes máquinas y a tomar nota de las razones de tales pérdidas.

Notas sobre la Fundición Americana de Tinyahuarco.

Sobre la línea del ferrocarril de la Oroya-Cerro de Pasco y en la quebrada de Tinyahuarco, distante 14 km. del Cerro de Pasco, se encuentra establecida la gran planta metalúrgica de la "Cerro de Pasco Mining Company," conocida con el nombre de "Smelter." La fundición, como acabo de decir, está unida por ferrocarril al puerto del Callao, del cual dista 340 km. y al asiento carbonífero de "Goyllarisquizga," 40 km.

Según datos que hemos recogido, la construcción de esta gran usina, fué comenzada en el año de 1904 y entró en funcionamiento en el año de 1906, es decir, que en menos de dos años, los americanos construyeron en el Perú, la primera usina metalúrgica sud-americana. Como llevo dicho, esta usina es la primera en Sud-América: 1°. por su importancia; 2°. por su capacidad; y 3°., porque ha sido la primera en establecer los convertidores, para llegar al cobre metálico. Hemos visitado la usina solo "una vez" y a la ligera de manera, pues, que no nos hemos podido dar cuenta a conciencia de la usina, como para hacer una descripción completa y detallada; pero sin embargo, haremos una descripción ligera de sus principales secciones, complicadas instalaciones y de los procedimientos usados.

Las secciones principales de que consta, son las siguientes:

1°. La máquina para sacar muestras.
2°. La casa de fuerza.
3°. El lavador de carbón.
4°. Los hornos de coke.
5°. La sección de tostado.
6°. El departamento de fundición.

La máquina para muestras es un enorme aparato mecánico, que recibe el mineral después de pesado en los mismos carros, como viene del Cerro de Pasco, en una báscula especial de kilos y toneladas, instalada frente a la estación central. El aspecto exterior, es el de un Bin. El "sampling mill," solo recibe la quinta parte del mineral que llega a la usina; una vez el mineral en la máquina, principia a moverse una serie compleja de maquinarias que dan por resultado el poder obtener el común exacto. Este común se recibe en pequeños aparatos muestradores, donde es reducido a 1 o ½ kilo que pasan luego al laboratorio de ensayes. Es un poco laborioso y deja asombrado el juego de estas máquinas y sobre todo, el ruido, a la persona que por vez primera lo observa.

La casa de fuerza tiene cuatro compresoras de aire, que reciben éste a 16 atmósferas en el cilindro de baja presión, luego pasa al de media presión con 20 y después al de alta con 60 atmósferas; trabaja con 130 libras de presión por pulgada cuadrada, consume cada una 1200 HP; tiene también ocho grandes calderos del tipo "Babcock y Wilcox" en los que se emplea el carbón grueso del coal-washer; ocho motores del tipo "Corliss" con poder de 3800 HP, de los cuales sólo la compresora para los convertidores consume 1550 HP. Existen también cuatro ventiladores del tipo "Root" núm. 11, para los water-jackets, con sus motores respectivos; hay también un dinamo tipo "Westinghouse y de corriente alterna trifásica de 480 kw, movido por una turbina "Leffel," cuya corriente se utiliza en un motor eléctrico que mueve la maquinaria de las diversas dependencias.

También existe otro dinamo de corriente alterna para el alumbrado con lámparas de arco.

El lavador de carbón es la sección de concentración de la hulla de "Goyllarisquizga," "Quishuarcancha," "Oyón," etc., antes de la fabricación del coke. El carbón menudo de "Goyllarisquizga," como veremos más adelante, viene con 30 a 40 por ciento de impurezas, luego es sometido a una molienda gruesa y después pasa al lavado, que se efectúa en una serie de cribas y jigs que dan tres productos: 1°. un carbón para fabricar el coke que viene a representar el 50 por ciento más o menos del total pasado; 2°. un carbón para calderos, ambos van al colector general; y 3° un residuo pizarroso que se bota. Entran diariamente 600 toneladas de carbón menudo.

Según datos tomados en el laboratorio, la composición media del carbón de "Goyllarisquizga," es la siguiente:

	Por ciento.
Carbón fijo	39
Materias volátiles	41
Cenizas e impurezas	20

La sección de fabricación del coke, consta de 74 hornos agrupados en serie, en dos líneas paralelas, formando un sólo macizo y distribuidos 37 a cada lado, con capacidad de 8½ toneladas cada uno. La hulla tiene la siguiente composición:

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	Por ciento.
Carbón fijo	63.00
Materias volátiles	1.60
Sílice	20.00
Alúmina	10.30
Fierro, cal, azufre, etc.	5.10

Es alimentada por el techo de los hornos, sobre el cual corren carros cargados de hulla que circulan por una red ferroviaria, tendida para ese objeto.

Se carga y descarga cada 24 horas. La descarga (coke) viene a representar el 46 por ciento de la carga.

La sección dé tostado consta de cuatro hornos del tipo "Mc Dougal," de sección cilíndrica y cinco hornos de reverbero, donde se realiza el tostado en polvo.

Para el tostado aglomerante o "sintering," posee 14 ollas más grandes que las de Casapalca y ,de forma especial.

El departamento de fundición, consta de dos secciones:

a. (Sección de los Water-jackets, que ocupa el lado izquierdo y consta de cinco water-jackets rectangulares de 2.97 m. por 1.65 m. a nivel del tragante, con 30 toberas cada uno, 15 cada lado mayor. La capacidad de cada horno, es de 235 toneladas. Los minerales que entran al horno tienen una ley desde 2.75 por ciento hasta 15 por ciento de cobre; las mezclas tienen un promedio de 8 por ciento de cobre y desde 0.1 hasta 0.4 kg. de plata por tonelada. Todos estos minerales vienen de las minas del Cerro de Pasco; también vienen de Morococha y otros lugares. Como ya hemos dicho, en otra oportunidad, todos estos minerales tienen abundante cantidad de fierro y azufre conteniendo igualmente plomo y zinc.

El lecho de fusión para las cargas del horno, se prepara en carros de... 1,350 kilos, arrastrados por pequeñas locomotoras a vapor, en las siguientes proporciones:

	Kilos.
Mineral crudo	800
Mineral tostado	50
Escorias del convertidor	250
Caliza	250
Coke de "Goyllarisquizga"	135
Coke extranjero	81

La mata y la escoria se separan en aparatos especiales llamados "settlers." La escoria sólo tiene 0.20 por ciento de cobre y se granalla para botarla, cuando no se hacen ladrillos para construcciones, &. La mata tiene 38 por ciento de cobre y en algunos casos alcanza a 43 por ciento siendo su ley en plata de 1.2 kg. por tonelada.

La sección de los convertidores, ocupa el lado derecho y actualmente existen 12 convertidores del tipo "Cerro de Pasco" y dos cilíndricos estando dispuestos frente a los water-jackets. Los convertidores tipo "Cerro de Pasco" tienen doce toberas cada uno y están revestidos de una mezcla de cascajo y cada revestimiento dura cinco campañas. La mata es recibida del water-jacket, en una taza de siete toneladas, luego se levanta por medio de una grúa eléctrica y es vaciada al convertidor. Inmediatamente después de cada carga, principia la insuflación del aire y como a los veinte minutos se escorifica; en seguida se vacía al convertidor una nueva taza de mata; al cabo de media hora de insuflación de aire, se escorifica nuevamente, se deja reposar el cobre por unos cinco minutos y se vacía por fin en moldes de 90 a 100 kilos.

Los lingotes de cobre tienen la composición siguiente:

	Por ciento.
Cobre	97.00
Plata	0.46
Plomo	0.57
Fierro	0.33
Níkel	0.02
Azufre	0.53
Sílice	0.09

La producción de la "Smelter" es de 80 toneladas diarias y las barras de cobre se exportan por el Callao a la usina americana de Baltimore.

Tiene además la planta de fundición un gran taller de carpintería, instalación de soldadura autógena para soldar las piezas de fierro o acero de los water-jackets, &; un magnífico taller mecánico, maestranza, &. Visitamos también el hermoso y completo laboratorio de ensayes, que no deja nada que desear.

El número de operarios pasa de 1.500. El jornal es variable: los del horno ganan S/.4 y 6, los demás S/.2, 3 y 1,50.

Los americanos en la fundición carecen de un elemento esencial, cual es el agua, y esto lo deben a la mala ubicación de la planta, pues han debido establecer ésta, no en "Tinyahuarco," sino cerca de "Huaraucaca" a orillas del río "San Juan;" los americanos tienen que bombear el agua precisamente del sitio a donde debieron establecer su planta y como esto es costoso, economizan el agua que sale de los water-jactcets haciéndola pasar por "torres de enfriamiento," de las cuales tienen dos de madera, para luego que la enfrían, volverlas a utilizar.

Para tubos de vapor se puede hacer un buen cemento moliendo pesos iguales de buen barniz de aceite de linaza, albayalde, y óxido de manganeso y barro.

Para sujetar las herramientas a sus mangos se emplea con buen éxito la siguiente composición que se hace tomando cuatro partes de resina negra, una parte de cera de abejas, una de polvo fino ladrillo y mezclándolo todo junto.

La presión media de la atmósfera se calcula que es de 14.7 libras por pulgada cuadrada, por lo que con un vacío perfecto sostendría una columna de mercurio de 29.9 pulgadas o una columna de agua de 33.9 pies de altura.

La Creosota en la Preservación de la Madera.

Según los experimentos llevados a cabo en los Estados Unidos de América los aceites de creosota extraídos de las maderas de construcción que han estado en uso durante muchos años tiene un promedio de 32.9 por ciento de destilado bajo 270° centígrados y 66.8 por ciento de aceites de alto punto de ebullición. Los defectos de la mayoría de los preservativos modernos de creosota residen en la deficiencia de los aceites básicos de alto punto de ebullición y en la substitución de ellos por el alquitrán u otras substancias viscosas. Bajo las debidas condiciones de destilación podría ser manufacturado un aceite grueso de creosota del alquitrán no conteniendo nada que hierva bajo una temperatura inferior a 210° Centígrado, paro para usos generales no destilará más del 50 por ciento del total a una temperatura menor de 315° Centígrado, y para blocks de madera para pavimentos no más que el 35 por ciento. Las cualidades que se exigen son fuerza de penetración, estabilidad y protección contra el agua, cuyas cualidades posee el aceite puro de creosota.

El alquitrán tiene una fuerza de penetración muy baja aun cuando se le inyecta a alta temperatura; y la madera tratada con una mezcla muestra una separación de los componentes o sean el del aceite, el alquitán y el carbón en las orillas de las argollas de grano cerrado.

Con relación a la estabilidad, las pérdidas ocurren debido a la volatilización, extracción por el agua y cristalización en la madera impregnada con aceites ligeros de creosota.

El valor preservativo puede depender directamente de la acción antiséptica o de la adhesión permanente de la capa estable de aceite a las paredes de las celdillas más diminutas, pues la acción de formarse o adherirse en la parte exterior en forma de película es de poco valor, preservativamente hablando.

En los accites ligeros los constituyentes antisépticos son los que predominan, pero son volátiles y de una gran solubilidad en el agua. Los aceites gruesos son suficientemente ricos en substancias análogas a la creosota y por consecuencia su potencia preservativa es más estable. La impermeabilidad también depende del recubrimiento completo de las paredes de las celdillas con una capa oleaginosa que excluye la humedad.

La gravedad específica del vapor (a la presión atmosférica), es de 0.469 veces la del aire a 32° Fahrenheit y .0006 veces la del agua a la misma temperatura.

La Industria del Yodo en Chile, S. A.

La República Chilena es el país mayor productor de yodo del mundo, pudiendo fácilmente aumentar su actual producción si las necesidades del mercado mundial así lo exigiesen. El cuadro adjunto demuestra la producción del yodo desde 1879 a 1913:

Producción de yodo de 1879 a 1913.

Años.	Kilogramos.
1879-1902 (271.633 kg. anuales.	6.117.237
1903..	387.275
1904..	461.484
1905..	564.230
1906..	351.220
1907..	289.826
1908..	330.090
1909..	474.209
1910..	581.432
1911..	437.488
1912..	458.342
1913..	436.971

Siendo el yodo un producto de consumo limitado, los productores de esta substancia de todo el mundo han celebrado un convenio para regularizar la producción. Los productores chilenos han formado desde 1886 la llamada "Combinación del yodo" por la cual se comprometen a consignar toda su producción a la casa A. Gibbs, de Londres. Esta firma regula, por lo tanto, la producción del país, indicando la cantidad que debe exportarse mediante disposiciones especiales, cada productor obtiene así una participación en esa exportación. La misma casa A. Gibbs, mediante arreglos con la casa Leisler Bock y Cía., Glasgow, regula la producción del yodo en Europa y en el Japón.

Con este sistema acontece que no todos los productores producen su yodo, sino que venden su participación a otros productores que pueden elaborarlo a precios más ventajosos y con esto los productores que deberían poseer varias fábricas, poseen sólo una y en ella elaboran la participación de todo lo que les corresponde.

Mediante la "Combinación del yodo" se ha logrado mantener los precios de esa substancia a una cifra que les produce considerables beneficios, no sólo a los productores chilenos sino aun a los europeos y japoneses, siendo los precios medios del kilogramo de yodo en oro chileno, los siguientes:

Años.	Pesos oro chileno.
1899..	13,41
1901..	12,12
1906..	12,50
1907..	14,50
1908..	10,09
1912..	10,71
1913..	13,41

Todo el yodo que se exporta de Chile, proviene de las aguas madres o viejas de la cristalización del nitrato de sodio. El yodo se encuentra en los depósitos salitrales chilenos, situados en la región norte del país entre los paralelos 19 y 26 de latitud Sur, acompañando al nitrato de sodio natural.

El yodo existe en dos de las capas geológicas de la formación típica salitrera chilena, llamadas "costra y caliche". Como se sabe, ambas capas están formadas principalmente por sales de sodio, nitrato, cloruro y sulfato mezcladas en diversas proporciones con substancias insolubles, arcilla, trozos de piedra, etc. Ha sido Lambert quien primero señaló en 1843 la existencia del yodo en los minerales de nitrato de sodio; más tarde Jacquelain en 1855, confirmó lo asegurado por Lambert encontrando que el yodo se presentaba en dichos minerales en forma de yoduro y yodato de sodio. Guzard en 1874, lo encuentra en forma de yoduro, yodato, peryodato de sodio y yodato de potasio, mientras que Gruneberg afirma que se encuentra en forma de yoduro doble de sodio y magnesio.

Posteriormente en 1891, el doctor A. Dietze, químico de la Compañía Salitrera Lautaro, dió a conocer dos compuestos del yodo encontrados en las pampas de Taltal, la Lautarita, $Ca(IO_3)_2$ y la Dietzeita, cromoyodato de calcio de fórmula, $7Ca(IO_2 + 8CaCrO$.

A pesar de lo asegurado por algunos de los investigadores más arriba citados, no parece existir en la costra, ni en el caliche yodo en forma de yoduro; los yoduros se encuentran sólo en las aguas viejas o madres que provienen de la cristalización del nitrato de sodio, o en el nitrato de sodio cristalizado; en ambos casos su formación es secundaria, se han producido durante el tratamiento del caliche en los tanques de lixiviación.

El yodo se presenta, pues, en el caliche en forma de yodato de sodio y sobre todo en forma de yodato y cromoyodato de calcio, raras veces en forma de yodo libre. Los caliches puros son generalmente pobres en yodo, mientras que los bancos de cloruros y sulfatos que cortan las capas de caliche son relativamente ricos; un caliche de color amarillo, llamado azufrado o azafranado, que contiene mucho cromoyodato, es el rico en yodo.

Las leyes del yodo de la costra y caliche son muy variable, de 0,05 a 0,1 por ciento son los más comunes, 0,2 por ciento es considerada como superior y por excepción se llega a 0,5 por ciento.

En 1825 el doctor Francisco Puelma y Enrique Jecquier iniciaron los primeros ensayos para extraer el yodo de las aguas madres, pues debido al poco consumo del yodo y a lo imperfecto del método usado, al extracción fué paralizada ese mismo año.

1855, Jacquelain al estudiar las primeras muestras de caliche, propuso un procedimiento para la extracción del yodo, eliminando el yodo que se encontraba en forma de yodato por el anhidrido sulfuroso y el yodo de los yoduros por el cloro. A un volumen determinado de aguas madres provenientes de la cristalización del nitrato, se agregaba una disolución de ácido sulfuroso, hasta que el I_2 se depositaba, se la filtraba y se sometía después a la acción de una corriente de cloro, se precipitaba una nueva cantidad de yodo que se recogía después.

En 1868 la Société Nitriere de Tarapacá exportó el primer yodo extraído de las aguas madres del nitrato preparándolo por el procedimiento Thiercelin. Este procedimiento consistía en tratar las aguas viejas con una mezcla de ácido sulfuroso y sulfito ácido de sodio. Thiercelin hizo también ensayos para implantar otro procedimiento que consistía en usar los gases nitrosos; estos gases se obtienen inflamando la mezcla de nitrato de sodio y carbón y una poderosa corriente de aire arrastraba los gases nitrosos, los que se hacían actuar sobre las aguas viejas.

En 1873, J. Langhein introdujo un sistema par atransformar el yodo en yoduro de cobre; este sistema estuvo varios años en uso y ha sido descrito por Lowe y Weissflog y por M. A. Prieto, quien lo vió en trabajo en la compañía de Salitres de Antofagasta, a fin de reducir completamente todos los yodatos a yoduros y aprovechar la ventaja de la mayor solubilidad de éstos sobre aquéllos, la reducción no se efectuaba sobre las aguas viejas sino sobre los caldos de disolución; a los tanques de lixiviación se agregaba sulfuro de calcio, que en contacto con el agua producía H_2S, cuerpo que reducía los yodatos a yoduros. La reducción se concluía tratando las aguas viejas con sulfato ferroso y con sulfito ácido de sodio. Las aguas madres se concentraban hasta una producción conveniente y se formada el yoduro de cobre por doble descomposición con el sulfato de cobre; el yoduro formado se recogía por filtración, se lavaba y se secaba.

En 1880 se ensayó sin éxito el procedimiento electrolítico Parker-Robinson que consiste en electrolizar los yoduros alcalinos en presencia de un exceso de ácido sulfúrico.

E 1881 el señor Julio Scheffer patentó un procedimiento de su invención y los aparatos correspondientes para extraer el yodo. El procedimiento consiste en aplicar el cloro a los gases nitrosos sobre las aguas viejas calientes.

Las aguas viejas atraviesan una torre construida de material inatacable y provista de material de relleno, coke, sílice, etc., entrando los gases por la parte inferior de la torre. El yodo arrastrado por el líquido se separa en un tanque decantador.

Ese mismo año Lowe y Weissflog patentaron un método para extraer el yodo, tratando el agua vieja por su cantidad correspondiente de sulfato de aluminio. El yodo en forma de yoduro se precipita inmediatamente, los yodatos se transforman en yoduros por la acción de reductores; sulfuros, polisulfuros y sulfiitos alcalinos; cuando se usan sulfitos o hiposulfitos se precipita alúmina, obteniéndose yodo impuro, que es necesario purificar por sublimación. Los mismos autores, en dos patentes posteriores modificaron el sistema que habían propuesto; a fin de aprovechar la mayor solubilidad de los yoduros, reducen durante la elaboración del caliche los yodatos, valiéndose del sulfuro de calcio, del sulfhidrato de sodio, etc. La precipitación de yodo se hacía en forma de yoduro de cobre por medio del Cu_2Cl. El procedimiento expuesto es especialmente recomendable cuando los caliches tienen sales solubles de magnesio, que el H_2S desprendido precipita en forma Mg (O_2H); estas sales de magnesio impiden que el nitrato de sodio preparado se seque completamente. Los procedimientos de Lowe y Welssflog fueron utilizados durante algunos años por la Compañía de Salitres de Antofagasta y abandonados por dar un costo demasiado elevado.

Las patentes de los doctores Puelma, Puelma Tupper y Gamboni dieron al procedimiento de extracción del yodo la forma que hoy tiene, modificando el modo de operar y los aparatos anteriormente utilizados. La patente número 520 fué utilizada por la Compañía de Salitres de Antofagasta, para reemplazar al procedimiento Lowe y Weissflog, que hasta esta época había usado. La patente Gamboni fué adquirida por la casa Gibbs y los salitreros de Tarapacá. He averiguado que las pequeñas modificaciones de detalle que patentó Gamboni, lo fueron después de conocer perfectamente el procedimiento Puelma, ya instalado en Antofagasta y que la Compañía de Salitres mantenía en riguroso secreto.

El doctor Gilbert patentó en 1885 el procedimiento siguiente para extraer el yodo de las aguas madres del salitre. Efectúa la reducción de los yodatos a yoduros, valiéndose del bisulfito de sodio, agitando fuertemente la mezcla de los líquidos, mediante el aire comprimido y una vez precipitado el yodo agrega sulfuro de carbono, agitando de nuevo el líquido por medio de una serie de paletas; las disoluciones se decantan y destilan a 50 grados la disolución de yodo en sulfuro de carbono, recuperando así casi todo el sulfuro.

En 1886 A. Hermann transformó el procedimiento de Thierceiin por medio de los gases nitrosos; el nitrato de sodio se descompone en retortas de hierro herméticas por la sílice o arcilla; los gases que se desprenden de la reacción actúan como reductores de las aguas viejas.

Las últimas patentes concedidas sobre yodo pertenecen al año de 1900. El señor Elías M. Benítez patentó la extracción del yodoformo y del yoduro de potasio, de las aguas viejas del salitre, cuando en realidad usa los procedimientos ya descritos para obtener de las aguas viejas el yoduro de cobre y trasforma después el yoduro de potasio y éste a su vez en yodoformo; ambas transformaciones las hacen por procedimientos muy usados en la industria química. El señor Alfredo Puelma Tupper patentó tres diferentes procedimientos para extraer el yodo, en los cuales sólo se encuentran modificaciones a los procedimientos anteriormente descritos. Consiste el primero en reducir por el bisulfito de sodio sólo los 5/6 del agua vieja, agregando después el 1/6 restante a fin de obtener la precipitación completa; el autor estima que en la práctica son éstas las proporciones más eficaces; en su segundo procedimiento propone reducir los yodatos por los gases nitrosos fabricados, quemando salitre con carbón en una corriente de aire, la reducción sería más eficaz usando el NO_2 líquido extraído de los gases anteriores; el tercer procedimiento consiste en reducir en los 5/6 de volumen de las aguas viejas el yodato, por el H_2S que desprende el CaS; se agrega después el 1/6 restante y una cantidad suficiente de H_2SO_4.

Procedimiento actual.

Actualmente todas las plantas usan el mismo procedimiento: reducción de los yodatos por el bisulfito de sodio y percipitación del yodo, por reacción del yoduro formado sobre el yodato.

Según C. E. de la Mahotiere, antiguo químico de la Compañía de Salitres de Antofagasta, la precipitación del yodo se puede explicar por las siguientes reacciones:

$$NaIO_2+3NaHSO_3=NaI+3NaHSO_4$$
$$5NaI+NaIO_3+3H_2O=3I_2+6NaOH$$

El líquido se pone ligeramente alcalino y una pequeña parte del yodo precipitado se disuelve en él.

Según don Alfredo Puelma Tupper las reacciones se pasan de una manera un poco diversa; en vez de formarse yoduro de sodio, ha podido evidenciar la formación de ácido yodhídrico:

$$NaIO_3+3NaHSO_3=H_2SO_4+2Na_2SO_4+HI$$
$$10HI+2NaIO_3+H_2SO_4=6I_2+Na_2SO_4+6H_2O$$

Semper y Michels se muestran partidarios de esta última explicación.

La industria del yodo no sólo comprende la obtención de este cuerpo sino que también la fabricación de todos los reactivos que entran en su fabricación.

Se comienza por fabricar primero carbonato de sodio, el que mediante el anhídrido sulfuroso se forma en bisulfito de sodio.

La obtención del carbonato de sodio impuro—"sal-natron o sal-itron"—como se le llama en la industria; se efectúa por medio de nitrato de sodio y de carbón.

La reacción se efectúa en un horno abierto, formado por un plano inclinado circular, en comunicación con un pozo más profundo. En el plano inclinado se coloca la mezcla de nitrato de sodio y carbón de piedra, en ambos cuerpos, bien molidos y secos; se prende fuego por medio de carbón en ignición; la reacción se produce violentamente, con desprendimiento de gases nitrosos; el carbonato de sodio obtenido por efecto del calor de la reacción se funde y escurre hacia el pozo, donde se solidifica al enfriarse.

Una vez frío, se extrae del pozo, se rompe en trozos y se trata con agua en estanques especiales, hasta formar una disolución de densidad aproximada a 1.10; la solución se decanta y el líquido claro se guarda en los tanques de sal natron.

La preparación del bisulfito se hace del modo siguiente: En hornos especiales se quema azufre, cuya combustion se mantiene merced a una corriente de aire, producida ya por aire comprimido, ya por medio de un inyector de aire y vapor; el anhídrido sulfuroso producido es enviado a dos grandes cilindros de palastro, incompletamente llenos con la disolución de sal natrón; para producir el borboteo del anhídrido sulfuroso, se produce una depresión en la parte superior del líquido mediante un aspirador de vapor. La disolución de bisulfito, una vez preparada, tiene una densidad de 1,25 a 1,13. La disolución obtenida se guarda en los estanques depósitos de bisulfito.

Una vez obtenidos los líquidos reactivos el procedimiento puede seguir su marcha normal. Las aguas viejas o madres son enviadas desde las bateas de cristalización del nitrato hasta el estanque de aguas viejas, gran depósito situado a cierta altura, desde el cual las aguas pasan a los estanques donde se verifican las reacciones.

Las aguas viejas son de composición muy variable, generalmente no tienen más de 5 gramos de I por litro, y de 1 a 3 gramos es la ley más general. Como ejemplo de aguas viejas pueden citarse las siguientes:

$NaNO_3$	382,89	378,53	382,87	382,87	—
NaCl	204,10	147,52	77,41	77,41	—
$NaIO_3$	12,51	13,34	8,72	8,72	—
KNO_3	—	116,52	123,48	123,48	—
$Ca(NO_3)_2$	71,05	—	101,11	101,11	—
$Mg(NO_3)_2$	88,05	—	—	—	—
$KClO_4$	ind.	6,17	2,14	2,14	—
$MgCl_2$	—	1,69	—	—	—
$MgSO_4$	—	—	1,54	1,54	—
$Na_2B_4O_7$	—	4,43	3,28	3,28	—
H_3BO_3	—	44,39	41,33	41,33	—
$KClO_3$	—	8,39	6,72	6,72	—
$NaClO_3$	—	0,28	ind.	ind.	—
$Mg(ClO_3)_2$	—	—	53,56	53,56	—
Densidad	1,425	1,425	1,463	1,463	—

El agua madre es tratada por el licor de bisulfito de sodio, preparado de la manera ya dicha; generalmente esta mezcla se hace agregando un ligero exceso de la disolución de bisulfito hasta que el líquido que resulta presenta una coloración oscura, parecida al cognac; a este licor se agrega una nueva cantidad de agua vieja, la cuarta o la quinta parte de la primera y todo el yodo se precipita; llamándosele a esta segunda operación "cortar" el yodo.

El líquido se deja reposar, y sobre la parte líquida que sobrenada se ensaya, ya sea con agua vieja, ya con la disolución de bisulfito si la reacción ha sido completa, corrigiéndose después por agregado de agua vieja o bisulfito en caso de necesidad.

Cuando el procedimiento es mal llevado, sucede que si hay un exceso de bisulfito, las reacciones se prosiguen en los aparatos en que se efectúa la disolución del caliche—en los cachuchos— y dada la temperatura a que se efectúa la operación (alrededor de 100°) se producen desprendimientos de vapores de yodo. En el caso contrario, cuando hay un exceso de agua vieja, se forma una espuma que impide la rápida decantación del yodo.

La operación de cortar el yodo se efectúa en una serie de estanques—generalmente doce—colocados uno al lado de otros y unidos por medio de cañerías con los estanques de aguas viejas y los que contienen las disoluciones de hiposulfito y carbonato de sodio. Los estanques de cortar yodo que se construían primitivamente de madera, son hoy en la mayoría de los casos de hierro, de una capacidad de 6 metros cúbicos, de dimensiones variables, más profundos de un lado que de otro, de manera que permitan sacar fácilmente el yodo precipitado. La reacción es ayudada con un movimiento enérgico de los líquidos, para lo cual en algunas plantas se hace uso de un sistema de aspas de madera y en otras se emplea el aire comprimido, que se hace borbotar por medio de un inyector especial.

Las cantidades de aguas viejas y de disolución de bisulfito que es necesario emplear para obtener una buena precipitación, son cuidadosamente calculadas de antemano; el "mayordomo cortador de yodo," mediante la bureta, determina la cantidad de líquidos necesarios para preparar el licor y obtener después la precipitación completa.

Los líquidos se dejan reposar en el estanque cortador de yodo, durante unas seis horas y luego se decantan; la parte clara, denominada "agua feble," es enviada a un estanque especial y de ahí vuelve al ciclo de la disolución del caliche. A pesar de las múltiples precauciones empleadas para obtener una precipitación completa del yodo, las aguas febles contienen siempre pequeñas cantidades de 0,1 a 0,3 gramos por litro. El residuo del estanque que contiene el yodo precipitado se filtra a través de tejidos o fieltros especiales; los estanques filtros están formados por un recipiente cilíndrico y un embudo tron-cónico que ajusta sobre el recipiente; entre ambos se fija el tejido, el cual es mantenido por el embudo.

La materia sólida que queda sobre el filtro, es cuidadosamente prensada en prensas de hierro a fin de quitarles la mayor cantidad posible de agua; se forman así los "quesos, tortas o pastas de yodo," cuya composición media es:

	Por ciento.
I	70 a 80
Resíduo	5 a 10
Humedad	10 a 15

Las prensas se componen de un cilindro hueco de hierro colado, abierto por sus dos extremidades; la parte inferior del cilindro descansa sobre una pieza de madera, agujereada, y por la parte superior ajusta un disco de madera, movido por tornillo de prensa. Los filtros de género, se introducen dentro del cilindro, envueltos en un tejido grueso que no permita sino el escurrimiento del agua.

El yodo en pasta o en queso, se purifica por sublimación, operación que se efectúa en retortas de hierro, condensando los vapores en tubos de loza inglesa vidriada que enchuflan unos en otros.

Las retortas son de hierro colado cubiertas de mampostería y alimentadas por su parte superior por fuego directo. Interiormente la retorta se cubre de arcilla a fin de preservar el hierro de los vapores del yodo; frente al hogar se encuentran la puerta por donde se introducen los quesos de yodo, la parte opuesta tiene una abertura que corresponde a los recipientes donde se condensa el yodo. Los aparatos condensadores o "paipas" son tubos de loza inglesa vidriados interiormente y enchufan unos dentro de otros; tienen 75 centímetros de diámetro por 90 de largo; generalmente cada retorta necesita diez tubos de condensación, que se colocan dándoles una posición inclinada.

Para efectuar la destilación, se llena la retorta con la pasta de yodo, se cierran cuidadosamente todas las junturas con arcilla y se calienta la retorta suavemente, hasta que todo el yodo se haya sublimado; se deja enfriar el aparato durante varios días y sólo se abre en la noche, pues el calor del día volatilizaría parte del yodo y los vapores producidos impedirían el trabajo de los obreros. El yodo sublimado se presenta pegado a las paredes de las "paipas" en forma de grandes cristales de brillo metálico, de color violáceo oscuro; se despegan éstos de las paredes y se les coloca en pequeños barriles de madera, muy resistentes, de 50 a 60 kilogramos de peso. Estos barriles se recubren con un forro de piel fresca a fin de impedir las pérdidas durante el viaje al extranjero.

El yodo sublimado, obtenido de la manera dicha, es suficientemente puro para ser empleado directamente. Los análisis de numerosas muestran acusan la siguente composición media:

	Por ciento.
Yodo	98,85 a 99,60
Cenizas	0,08 a 0,03
Humedad	1,05 a 0,25

Las diversas operaciones que hemos descrito se efectúan en un recinto especial de las plantas salitreras, conocido con el nombre de casa de yodo, ahí se agrupan los diversos aparatos usados en la preparación de los reactivos, precipitación y refinación del yodo; las casas de yodo están provistas de sólidas bodegas donde se guarda el yodo producido.

Precio de costo del kilogramo de yodo.

Es difícil de estimar exactamente el precio de costo del kilogramo de yodo. Hay varios de sus factores, que escapan al cálculo; es imposible determinar el porcentaje que a cada kilogramo de yodo producido le corresponde en los gastos de instalación, pues la fabricación es intermitente, sin sujertarse a reglas determinadas; los períodos de producción dependen del consumo mundial y del número de productores, factores ambos variables.

Los gastos de elaboración han sido calculados, en 1904 por Semper y Michels variables entre $2,14 a 2.50 oro chileno, hoy día según los estudios que he practicado, estos precios han variado un tanto, los estimo entre $2,40 a 4,00 según las oficinas.

El precio del kilogramo puesto en Europa se podría calcular del modo siguiente:

Gastos de elaboración	2.40 a 4.00	
Derecho	1.27 a 1.27	
Flete, seguro, comisiones, etc.	0.90 a 0.90	
	4.57	6.17

lo que equivaldría a tener un precio medio de $5,50 oro. Los diversos factores que concurren a formar este precio medio de costo se pueden clasificar del modo siguiente:

	Por ciento.
Materiales (salitre, azufre, carbón)	44
Derechos de exportación	23
Fletes, seguros, comisiones, etc.	16
Mano de obra	14
Envase	3

Precio de instalación de una casa de yodo.

Con el fin de dar una idea aproximada del capital invertido en la industria del yodo, damos a contiuación un presupuesto de una planta de yodo del modo corriente en la industria salitrera:

Edificios, albañilería, excavaciones, rellenos y encatrados de madera	20.000
Estanques de aguas viejas	3,600
Instalación para fabricar sal natron	1,000
Un estanque para disolver sal natron	2,750
Un estanque depósito de disolución sal natron	920
Cuatro hornos para quemar azufre	960
Ocho cilindros para fabricar el bisulfito	6,500
Dos estanques depósito de bisulfito (licor)	3,800
Doce estanques para cortar yodo.	12,500
Doce estanques para filtros	2,500
Cuatro prensas para yodo	1,500
Cinco retortas	3,750
Cincuenta paipas inglesas	2,500
Dos bombas Cameron	2,000
Un estanque aguas febles	3,600
Un comprensor de aire	1,500
Motor eléctrico y transmisiones y y tableros	1,200
Cañerías de hierro, de plomo, llaves, ruedas, válvulas, curvas, flanjes, etc.	2,000
Armadura del material	3,000
Total	$75,530

Una casa de yodo como la presupuestada puede fabricar con una ley de dos gramos de yodo por litro de aguas viejas 6.000 kilogramos de yodo mensuales.

Como hemos ya dicho no todas las oficinas elaboran yodo, el porcentaje es muy variable; cerca de 12 por ciento de las oficinas salitreras en trabajo anual, y cada oficina trabaja como término medio un mes cada cuatro a cinco años. Es casi imposible, por lo tanto, calcular la cantidad correspondiente a cada kilogramo de yodo, por capital, interés y amortización de la casa de yodo.

Para encontrar la fuerza necesaria en caballos para elevar agua a determinada altura, multipliquese el peso total del agua en libars por la altura en pies y divídase el producto por 33,000. Agreguese el 25 por ciento por la fricción del agua y 25 por ciento por la pérdida en el cilindro de vapor.

La Calidad de los Carbones de Hulla para Combustible.

(Continuación.)

Otro se archivará en el mismo laboratorio y el tercero se entregará al contratista, si así lo solicitare. Los frascos se lacrarán y sellarán con los sellos del laboratorio y del contratista.

Los ensayos prácticos de poder evaporante se harán solamente en los casos que la Dirección de las Obras Sanitarias de la Nación los juzgue necesarios. Estos se efectuarán con partidas no menos de (30) treinta toneladas por cada cargamento, y utilizando las calderas del establecimiento Recoleta para los cargamentos de carbón recibidos en Buenos Aires y las de los establecimientos de aguas corrientes de esta Administración en las cuidades de Paraná y Santa Fe.

Artículo 6°.—**Análisis y ensayos.**—Los análisis y ensayos los mandará efectuar el directorio de las Obras Sanitarias de la Nación por su propia cuenta.

Si el contratista no estuviere conforme con los datos obtenidos, podrá pedir la repetición de los mismos, debiendo pagar su importe a razón de (100) cien pesos moneda nacional por cada uno, si los nuevos resultados obtenidos concuerdan con los primitivos.

En las operaciones de repetición, el contratista podrá hacer intervenir, si lo desea, a un químico con diploma nacional para que presencie las nuevas pruebas.

Los análisis y ensayos se efectuarán siguiendo el orden y método que se describen a continuación:

Humedad: Sometiendo a una temperatura de 100° a 105° C cinco gramos de carbón del tamaño de dos a cinco milímetros en una atmósfera inerte durante tres horas.

Cenizas: Se colocarán dos o tres gramos de carbón en una cápsula chata de porcelana, la cual se pondrá primeramente e la entrada de la mufla y luego en su interior, dejándola allí hasta la incineración completa.

Materias volátiles: Se pesará un gramo de combustible en un crisol de platino de cuatro centímetros de altura y tres centímetros de diámetro, provisto de tapa. La separación de las materias volátiles se efectuará con un pico de Bunsen, que dé una llama de quince a dieciocho centímetros de largo, colocado debajo del crisol a tres centímetros de su fondo y se calentará hasta que por la tapa no se nota la salida de gases.

Poder calorífico: Se determinará siguiendo la marcha establecida, sobre el carbón secado en desecador de ácido sulfúrico y mediante la bomba de Berthelot-Mahler, haciendo las correcciones correspondientes. Se harán dos determinaciones por cada ensayo, tomándose el término medio.

Azufre: Para su determinación se seguirá el método de Eschka.

Polvo fino: Se pasará el carbón por cernidores de 2.00 m.) dos metros de largo por (1.50 m.) un metro cincuenta centímetros de ancho, de mallas de (0.003 m.) tres milímetros de luz y efectuándose la operación del modo siguiente: colocado el cernidor horizontalmente, se echará sobre él de (25) veinticinco a (30) kilogramos de carbón menudo, previamente tamizados con tamices de (0.105 m.) ciento cinco milímetros de luz; se imprimirá enseguida al cernidor cuatro movimientos completos de vaiven, a fin de separar el polvo fino. Se tomará el término medio de los resultados obtenidos en diez operaciones.

Poder evaporante: Se efectuarán cinco ensayos de veinte horas cada uno, consumiéndose de (7) a (8) ocho toneladas de carbón en cada ensayo, empleando el agua de alimentación a una temperatura comprendida entre 60° y 70° C. y determinando el volumen en litros de agua vaporizada por kilogramos de carbón ensayado. El término medio de los cinco ensayos indicará el poder evaporante del combustible ensayado.

Artículo 7°.— **Tolerancias y causas de rechazo.**—Todo cargamento de carbón que contenga proporciones mayores de materias volátiles, de azufre y de polvo fino que las especificadas en el art. 1°. de este pliego, será rechazada.

La humedad del carbón, está sujeta a aumentar por efecto de las variaciones atmosféricas, podrá superar el límite establecido, pero se tendrá en cuenta para los efectos de la reducción del precio como se indica en el art. 8°.

La cantidad de cenizas podrá también superar el límite admitido, hasta llegar a (10) diez por ciento, siempre que el punto de fusión no sea inferior a 1.300° C (Proost).

El poder evaporante, determinado prácticamnte no será nunca inferior a (10) diez litros de agua por kilogramo de carbón consumido.

El poder calorífico podrá disminuir hasta (7.000) siete mil calorías, que será el limite mínimo para la aceptación del combustible.

En los casos en que el carbón no satisfaga las especificaciones establecidas, la Dirección de las Obras Sanitarias de la Nación rechazará todo el cargamento, sin que el contratista tenga derecho a reclamo, y siendo de la exclusiva cuenta del mismo, todos los gastos ocasionados, sin perjuicio de lo establecido en el Art. 3° del presente pliego.

Artículo 8°.—Correcciones en el pre-

cio.—El precio que se establezca en el contrato estará sujeto a ser alterado, para cada cargamento, de acuerdo con las variaciones que indiquen los análisis y ensayos, con respecto a los límites establecidos y relativos a la humedad, cenizas y poder calorífico.

Si la proporción de humedad es mayor o menor que la estipulada se disminuirá o aumentará el precio proporcionalmente a la relación existente entre ésta y la obtenida en los análisis.

Si la cantidad de cenizas es mayor que el 5 por ciento fijado como máximo se descontará el (1,5 por ciento. uno y medio por ciento del precio por cada (1 por ciento) uno por ciento más de cenizas que contenga; si por el contrario, el carbón contiene menos del (5 por ciento de cenizas, se aumentará el precio unitario en (1,25) uno y cuarto por ciento por cada (1 por ciento) uno por ciento menos de cenizas que contenga. Dos por ciento (2 por ciento) en más o menos de este límite no harán variar el precio del contrato.

El precio variará también proporcionalmente al poder calorífico. La reducción o aumento de precio será proporcional a las variaciones tomando como punto de referencia (8.000) ocho mil calorías. Cien calorías en más o en menos de este límite no harán variar el precio de contrato.

Notas Sobre Ensayes.

El platino crudo existe en el mercado en la forma de pequeñas pepitas como de cien milígramos de peso para abajo. Pueden dividirse en términos generales en dos porciones la soluble y la insoluble en agua regia. La insoluble incluye el osmiridio como el único constituyente de valor, mientras que la soluble abarca el platino, el iridio, el paladio, el rodio y el oro. Se desea determinar con exactitud la cantidad justa de cada uno de dichos metales.

El Método.

Pésense 25 gramos de la muestra en un vaso picudo de análisis de 300 centímetros cúbicos. Agréguense 200 centímetros cúbicos de agua regia, (una parte de ácido nítrico a tres partes de ácido hidroclórico en volumen) y colóquese en baño-María durante una hora; luego póngase en un pedazo delgado de asbesto en la placa caliente y hiérvase cuidadosa y lentamente durante dos horas Quítese de la placa caliente y déjese asentar durante quince minutos y decántese la solución en otro vaso de análisis de 300 centímetros cúbicos, hirviéndose otra vez durante una hora hasta disolver todo metal que se encuentre en pequeñísimas partículas, las cuales se hayan decantado. Quítese de la placa caliente y llénese el vaso con agua. Revuélvase bien y déjese reposar durante una noche. Inmediatamente después de que se haya decantado el agua regia del vaso de análisis original, agréguense otros 200 centímetros cúbicos de agua regia al residuo que haya quedado y repítase el calentamiento y hervido del ácido. Finalmente, quítese de la placa, llénese con agua, bien y déjese reposar durante una noche. A menos que el material exista en pedazos de un tamaño mayor que el regular, la disolución de los minerales solubles se verificará en su totalidad con este tratamiento, el cual para llevarse a efecto se necesitará de un día.

Decántese la solución clara de ambas vasijas en un frasco volumétrico de 1000 centímetros cúbicos, teniéndose especial cuidado en que ninguna partícula insoluble se vaya con el líquido. Lávese el contenido de uno de los vasos de análisis en el otro de manera de tener todo en un solo vaso y para diluir el ácido antes de filtrar. Fíltrese en un papel de 9 centímetros en un frasco de 1000 centímetros cúbicos. Lávese el insoluble del vaso de ensaye y luego el papel hasta que la solución pase a través sin color alguno.

Determinación del osmiridio.

Pásese el filtro de papel y su contenido a un escorificador de 2 pulgadas y media y agréguese de 10 a 15 gramos de plomo granulado; llénese el nivel del escorificador con litargirio y derrítase en la mufla durante media hora. Déjese enfriar el escorificador, quiébrese y quítese el botón de plomo. Límpiese bien el botón de plomo martillándolo lo menos posible y colóquese en un vaso de análisis de 150 centímetros cúbicos y disuélvase el plomo con ácido nítrico diluído, (1 parte de ácido nítrico a tres partes de agua). Colóquese en el baño María para ayudar a la disolución y cuando todo el plomo se haya disuelto fíltrese en un filtro sin cenizas y lávese el residuo de osmiridio en el filtro hasta que quede exento de plomo. Séquese el filtro y sepárese de éste el osmiridio todo lo que sea posible y quémese el filtro de papel. Agréguese el osmiridio al residuo del papel séquese totalmente en la placa caliente y pésese como osmiridio.

La escorificación con plomo es con el objeto de limpiar el osmiridio de la arena, de los óxidos pesados, etc. El osmiridio es recolectado por el plomo y las impurezas son escorificadas. Se tendrá algún cuidado al quemar el residuo por razón de que el osmiridio perderá osmio si se le calienta al rojo, al aire libre. Por tal motivo el papel es quemado después de la separación del osmiridio.

Determinación del platino.

Llénese el frasco de 1,000 centímetros cúbicos conteniendo la solución de mineral hasta la marca. Mézclese bien vaciándola en otro frasco seco y volviéndolo a poner en el mismo durante cuatro veces. Tómese una probeta de 25 centímetros cúbicos que haya sido estandarizada cuidadosamente y póngase frente al frasco de 1,000 c. c. y enjuáguese con una porción de la solución sacándose en seguida dos probetas de solución y vaciándolas luego en un vaso de análisis de 75 c. c. Evapórense esos tantos en el baño María hasta secarse y agréguense a cada uno 5 c. c. de ácido hidroclórico diluído, (1 parte de ácido a 9 de agua), y caliéntese durante cinco o diez minutos. Déjese enfriar, y a menos que no esté perfectamente clara, fíltrese en filtros de papel de 5 y medio centímetros en vasos de ensaye similares. Lávese con agua hasta que los filtros de papel queden por completo incoloros, lo cual puede hacerse fácilmente con menos de 20 c. c. de agua.

Hágase cada porción de manera que contenga 25 c. c. y agréguese a cada una 8 gramos de c. p. cloruro de amonio y caliéntese en baño María durante una hora meneándolo de cuando en cuando. Quítese del baño y déjese reposar dos o tres horas, y si es posible, mejor durante una noche. Decántense las soluciones claras en un filtro sin cenizas en un vaso de 150 c. c. Déjese que corra toda la solución a través de él y luego lávese el precipitado de cloroplatinato de amonio, $(NH_4)_2\ PtCl_6$ en los filtros con una solución al 20 por ciento de cloruro de amonio. Déjese que toda la solución pase a través y luego lávese repetidamente al derredor de las orillas del papel con pequeñas cantidades de solución de cloruro de amonio hasta que el filtrado quede incoloro y los papeles blancos. Finalmente enjuáguense las orillas del papel con alhocol. Después de que todas las soluciones hayan pasado a través de los filtros colóquense estos con las puntas hacia abajo en unas tacitas de templar de Battersea, tamaño B. Cuidadosamente dóblense los bordes de los papeles de manera de incluir por completo el precipitado en un sobre de papel. Cúbrase el crisol y sujétese a un buen fuego rojo principiando a áplicársele poco a poco y aumentándolo gradualmente. Finalmente quítense las tapas de los crisoles hasta que se quemen los papeles. Después de fríos, pásese el platino al platillo de la balanza de ensaye y pésese. (El duplicado no deberá variar más de 2 milígramos) tomándose el promedio como el correcto o exacto.

La precipitación de $(NH_4)_2\ PtCl_6$ generalmente se hace con la adición de alcohol para reducir la supuesta solubilidad del precipitado. Se puede estar seguro de que con el método arriba descrito se pueden tomar 0.0004 gm. de platino en la solución dada de 25 c. c. precipitándolo, lavando con la cantidad usual de solución de lavar y recogiendo más que la mitad del platino original. La solubilidad bajo las condiciones expuestas se desatiende para este ensaye.

Las soluciones son calentadas en el

baño María por dos razones: primera, para lograr que todo el cloruro de amonio se disuelva con rapidez en la solución y segundo, para cambiar el precipitado de un estado amorfo a un arenoso y cristalino que en ese estado es filtrado y lavado con facilidad.

El precipitado de platino generalmente contiene iridio en forma de $(NH_4)_2$ $IrCl_6$. El iridio aleado con el platino en pequeñas cantidades de menos del 10 por ciento se disuelve con el platino en agua regia. Este se precipita con el platino; pero no tan perfectamente. Los vestigios que pasan la precipitación son después calculados con rodio.

El $(NH_4)_2$ $PtCl_6$ cuando es puro es de color amarillo puro. El compuesto de iridio tiene un color rojo intenso. Si el precipitado de platino contuviese dos décimos por ciento de iridio este le dará un tinte rojo. La cantidad de iridio contenida si no es más del 5 por ciento puede ser juzgada por el color del precipitado con una exactitud suficiente para calcular la ley del mineral.

Se verifica una ligera pérdida al quemar el precipitado de platino minorándose esa pérdida teniendo el cuidado de tenerlo dentro del filtro de papel y quemarlo lentamente.

Determinación del oro.

Combínese el filtrado de la precipitación del platino y agréguense 5 gramos de sulfato ferroso en solución de agua más HCl. Déjese reposar hasta que el oro se haya asentado. Fíltrese y lávese en el filtro; cámbiese a una tacita de templar y quémese el papel frente a la mufla. Cuando se enfríe envuélvase en laminilla delgada de plomo y copélese en la forma usual del oro.

Determinación del Paladio.

Agréguese al filtrado del oro como una quinta parte de su volumen de ácido hidroclórico. Agréguese un 10 por ciento de solución de yoduro de potasio de cinco en cinco gotas cada vez hasta que no se precipite más yoduro paladoso, (PDI_2) y caliéntese en la placa caliente hasta casi dejarlo que hierva. Enfríese, fíltrese y lávese con ácido hidroclórico diluído (1 de ácido por cuatro de agua), y lávese hasta librarlo del hierro. Pásese a un crisol de porcelana y quémese en la mufla con un buen calor al rojo. Caliéntese y humedézcase con unas cuantas gotas de ácido fórmico diluído para reducir el óxido, y séquese totalmente en la placa caliente. Pásese al platillo de la balanza de ensaye y pésese el paladio.

Los libros de texto generalmente describen el yoduro paladoso como de fácil solución en Kl. Esto es cierto, pero la presencia de una gran cantidad de HCl probablemente evita que conteniendo cualquier exceso de Kl se forme ácido hidriódico y cloruro de potasio. Esta precipitación es completa. La solución fuerte de ácido hidroclórico también evita la precipitación de los yoduros de cobre y plomo si solamente se usa una ligera cantidad de KI.

El ácido fórmido diluído reduce a metal los óxidos de paladio.

Determinación del rodio.

Al filtrado del PdI agréguense zinc c. p. hasta que la solución quede incolora calentándola al estar haciendo esta operación. Déjese que se disuelva todo el zinc y que el precipitado se asiente. Decántese la solución y lávese el precipitado tres veces por decantación con proporciones de 100 c. c. de agua caliente. Agréguese 25 c. c. de ácido nítrico diluído (1 de ácido por 3 de agua), y colóquese encima del baño María durante diez minutos. Fíltrese en un filtro sin cenizas y lávese dos o tres veces con aguas; caliéntese y redúzcase en hidrógeno y pésese como rodio más vestigios de iridio.

El zinc reduce todos los metales de platino de la solución. En este caso sólo el rodio y los vestigios de iridio se encuentran contenidos. El ácido nítrico disuelve cualquier metal básico que pudieran encontrarse presente; pero como el rodio recién precipitado se disuelve con mucha lentitud en el ácido nítrico el tratamiento no deberá prolongarse mucho.

Un ensaye representativo del metal crudo será el siguiente: Osmiridio, 20 fino; Pt, (conteniendo 3 por ciento Ir), 830: Pd, 5; Au, 30; Rh, 20 fino.

La fuerte coloración que los metales de platino comunican a las soluciones siendo el platino el que da la menor hacen la mejor guía para el operador en la práctica de las operaciones del lavado, precipitación del zinc., etc.

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*Datos Geográficos de la Parte Central de la Porción Norte de la Baja California, México.**

Los subscriptos fuimos comisionados por la Dirección del Instituto Geológico Nacional, para explorar la parte central elevada de la porción Norte de la Península de la Baja California, con el objeto de hacer un estudio geológico de esa porción de la Península e investigar, al mismo tiempo, los recursos naturales de aquella región del país. Nuestros itinerarios siguieron por lo tanto, hasta donde nos fué posible, esta parte central elevada de la Península o sean las crestas de las sierras de Juárez, San Pedro Mártir, y San Juan de Dios.

Nuestra exploración comprendió una extensión longitudinal, según el eje de la Península, de más 300 kilómetros, desde la línea divisoria con los Estados Unidos hasta la antigua misión de San Fernando, es decir, próximamente, desde el paralelo 32° 30′ hasta el paralelo 30° de latitud N.

(*) Parergones del Instituto Geológico de México.

Fisiografía.

Las sierras de Juárez y San Pedro Mártir aparecen como dos macizos montañosos, separados entre sí, por el amplio valle de La Trinidad, que establece un paso fácil y directo entre las costas del Golfo de California y las costas occidentales del Océano Pacífico.

La sierra de Juárez, conocida también con los nombres de sierra de El Pinal, sierra de La Laguna o sierra de Hanson, recorre el centro de la Península con una dirección general de 25° N.W.-S.E. en una extensión de cerca de 140 kilómetros, comprendida desde la línea divisoria, hasta la extremidad meridional de esta sierra, que muere en las llanuras del valle de La Trinidad, situadas a una altura media de 820 m. sobre el nivel del mar. En la sierra de Juárez dominan las altiplanicies que alcanzan alturas variables entre 900 y 1,770 m. (*) en tanto que en la sierra de San Pedro Mártir dominan los picos y las crestas.

Las crestas principales de la sierra de San Pedro Mártir, corren con una dirección media de 38° N.W.-S.E. y la extensión longitudinal de esta sierra, desde su extremidad boreal, formada por el cerro Chato, puede estimarse, aproximadamente en 90 kilómetros. Constituye esta sierra un importante elemento de relieve en el eje de la Península, pues en ella se encuentra la cima más elevada de la Baja California: el pico de Providencia a 3086 m. de altura absoluta. Entre los picos y las crestas de esta sierra se forman los pequeños valles longitudinales (llamados localmente "bajíos") de La Corona (2610 m.), Tasajera, Vallecitos, La Grulla (2140 m.), Encantada (2480 m.), Santa Rosa, Santo Tomás (1840 metros) y Santa Eulalia, que aunque son valles de corta extensión superficial, pues el más extenso de ellos (Santa Rosa) mide apenas unos diez kilómetros de longitud por cuatro de anchura, se prestan mucho a la cría de ganado, por el pasto que crece en ellos y el agua permanente que los riega.

Las vertientes de estas sierras contrastan notablemente: mientras que las pendientes del Pacífico son en lo general accesibles y algunas de ellas mueren gradualmente en los valles interiores de la Península, las del lado del Golfo de California son fuertemente

(*) Las alturas citadas en este informe, son todas alturas sobre el nivel del mar y la mayoría de ellas fueron tomadas con un barómetro metálico compensado.

acantilladas, casi inaccesibles, y presentan profundas escotaduras que forman cañones, entre los cuales citaremos como más importantes, comenzando de Norte a Sur, a los siguientes: Los Picachos, Juárez, Guadalupe y El Rubí, en la sierra de Juárez; y a los de San Matías, Esperanza, El Copal, El Diablo, Providencia, Encantada o La Ventana, El Cajón, Santa Rosa o La Suerte, Agua Caliente, El Carrizo y El Parral, en la Sierra de San Pedro Mártir.

En las partes altas de estas sierras crece una abundante vegetación arbórea compuesta principalmente de pinos de diversas clases que llegan a alcanzar dimensiones, en altura y espesor, muy considerables. Esta vegetación, como veremos más adelante, ayuda a la influencia bien conocida que sobre las condensaciones y precipitaciones atmosféricas, ejercen la altitud y relieve del terreno, y a ello se debe, en parte, que las lluvias en esta porción Norte de la Península no sean tan escasas como lo son en el centro del territorio. En efecto, en esta porción Norte de la Península se observan dos estaciones de lluvias: la estación de lluvias de primavera, que tienen lugar comunmente en los meses de julio a septiembre y la estación de lluvias de invierno durante los meses de diciembre a marzo, correspondiendo a la estación de primavera las lluvias más intensas. Es, pues, importante para la agricultura de la Baja California, conservar y aumentar esta vegetación arbórea y nos permitimos llamar aquí la atención de la Superioridad, sobre el hecho de que se incendian con frecuencia los bosques de las sierras o se tiran a veces, árboles grandes con el único objeto de recoger la miel que explotan los indios de esa región de la Península.

La sierra de San Juan de Dios corre con una dirección casi de N. a S., y se extiende en una longitud de cerca de 50 kilómetros, desde su comienzo al S. E. del Cerro Chato, hasta su extremidad meridional, cuyos contrafuertes mueren en una extensa llanura. En esta sierra dominan las mesas y picos aislados tales como Matomí (1700 m.), Soledad (1395 m.), San Miguel y San Juan de Dios (1320 m.). La vegetación que crece en ella es esencialmente espinosa y está formada por choyas, cardones, visnagas, ocotillo y cirios.

El clima de esta porción Norte de la Península es sano y muy frío en las partes altas, en donde caen fuertes nevadas (*) en los meses de diciembre, enero, febrero y marzo. Las variaciones diurnas de temperatura son a veces muy bruscas; nosotros anotamos en el mes de diciembre temperaturas mínimas hasta de —12° C. y máximas hasta de 32°8 C.; habiendo señalado el termómetro en un mismo día una temperatura de —7° C. a las 6 de la mañana y de 30°5 a las 2 de la tarde.

(*) Fuimos informados por algunos rancheros de la localidad que en inviernos crueles, la capa de nieve llega a alcanzar hasta 3 pies de espesor.

Geología general.

Las rocas dominantes en la región explorada son las rocas graníticas; pues con excepción de la sierra de San Juan de Dios, que es de origen volcánico en su mayor parte, y de las sierras recorridas, la de menor extensión, son granitos de diversas clases. las rocas que constituyen principalmente las sierras de Juárez y San Pedro Mártir. Pueden considerarse esas sierras como dos macizos graníticos, cubiertos en extensiones más o menos grandes, por pizarras metamórficas (gneisses y mica-pizarras), que se presentan a veces, muy plegadas y trastornadas.

Las pizarras metamórficas son anteriores a los granitos y son, probablemente, las rocas más antiguas de la región y en algunos lugares se ven sobre los granitos, como girones dejados por la erosión. Los granitos de esta parte de la República, han sido considerados como rocas intrusivas post-cámbricas (*) y presentan un agran variedad de texturas y composición mineralógica: allí se encuentra el granito porfiroide con fenocristales de feldespato orthosa rojizo, el granito de grano grueso, el granito de grano fino, el granito gneíssico, el granito de mica blanca, el granito de mica negra, el granito hornbléndico, en el cual la anfíbola hornblenda es, a veces, tan abundantet que reemplaza casi a la mica y por último se encuentran allí diversos tipos de pegmatitas.

En las partes altas de la sierra de San Pedro Mártir se ven a estas rocas graníticas agrietadas y desintegradas en grandes blocks que aparecen como amontonados irregularmente; en tanto que en la sierra de Juárez se ven con más frecuencia como mesas de alguna extensión superficial, cubiertas por los productos arenosos procedentes de su desintegración. La desintegración de los granitos en estas partes altas de la sierra es debida, principalmente, a las alternativas de calor y frío producidas por los bruscos cambios diurnos de temperatura a que hemos hecho referencia al tratar de la fisiografía de la región.

Las pegmatitas aparecen en los macizos graníticos de las sierras de Juárez y San Pedro Mártir, bien como diques o intrusiones que cortan a los granitos, o como capas intercaladas en los bancos de granito gneíssico. Como diques o intrusiones aparecen en los siguientes lugares: en el Campo Juárez, donde constituyen una parte del fondo sobre el cual descansan los aluviones auríferos de aquel campo minero; en el cerro de La Corona, en la sierra de San Pedro Mártir y en los alrededores de los aguajes de Santo Tomás y San Ramón en aquella Sierra; en este último lugar los diques tienen una dirección general de 70° N.E. con inclinación de 60° al N.W. y son notables por el gran número y dimensiones de los cristales de turmalina y láminas de mica que contienen. En capas intercaladas se encuentran en algunos lugares del valle de La Encantada, en los acantilados al N.W. del Pico de Providencia y en el cerro de Huimayac, situado al S.E. del valle de La Trinidad; en este cerro las capas de granito gneíssico tienen una dirección general de 5° N. W. con 20° de inclinación al N.E., llegando a alcanzar las capas intercaladas de pegmatita hasta 2 m. de espesor.

En la región explorada existen, además, rocas eruptivas antiguas tales como syenitas, gabbros y dioritas; pero estas rocas ocupan extensiones superficiales relativamente limitadas, con excepción de las dioritas que se encuentran distribuídas en alguna extensión, formando una parte de la sierra de San Juan de Dios (cerro Soledad), algunas sierritas al N. del valle de La Trinidad y E. del rancho de Los Pocitos; y en los alrededores de San Fernando, Sausalito y San Antonio.

Las rocas eruptivas de la serie moderna están representadas por andesitas, rhyolitas, basaltos y labradoritas. Estas rocas eruptivas dominan solamente en la parte meridional de la región recorrida (Sierra de San Juan de Dios); pues en la sierra de Juárez son escasas y en la de San Pedro Mártir faltan completamente. Las andesitas y rhyolitas, acompañadas de sus tobas y brechas respectivas, se encuentran formando mesas en el Cerro Quemado al E. de La Ciénega, en la sierra de Juárez y en los cerros de la Vinata (Vinata Romero y Vinata Vieja), al E. de la antigua misión de Santa Catarina; constituyen las extensas mesas volcánicas que se ven al N. E., E. y S. E. de la sierra de San Juan de Dios y forman también el importante cerro de Matomí. En algunas de estas formaciones volcánicas las andesitas se encuentran en la base de las erupciones y las rhyolitas y brechas rhyolíticas en la parte superior de las mesas o en la cima de los cerros. Las rhyolitas y basaltos se encuentran en el pico de San Juan de Dios y las labradoritas en la extremidad meridional de

(*) Para el objeto del presente informe, hemos querido ocuparnos aquí, bajo este título, solamente de las rocas de la región explorada y su distribución superficial, sin tratar de su génesis, historia geológica, etc., y nos referiremos especialmente a aquellas rocas que puedan tener alguna aplicación industrial.

(*) Véase "Geologic Map of North America" compiled by the U. S. Geological Survey in cooperation with the Geological Survey of Canada and Instituto Geológico de México, under the supervision of Bailey Willis and George W. Stose. 1911.

la sierra de Juárez, al N. E. del valle de La Trinidad; en los cerros de La Ciénega, en esa misma sierra, y en los cerros de Los Picachos a unos 20 kilómetros al Sur de la línea divisoria, en donde descansan sobre el granito de la sierra y forman las cimas más altas de aquellos cerros.

Las únicas rocas sedimentarias que se encuentran en la región recorrida por nosotros, son las areniscas y conglomerados volcánicos que forman el subsuelo del rancho de San Juan de Dios y la parte inferior de las mesas de las cercanías de ese rancho; y algunas calizas que aparecen en fajas y gruesos bancos en los alrededores de San Fernando y en los criaderos de ónyx de la "New Pedrara Co." En los alrededores de San Fernando los bancos tienen una dirección general de 17° S. E., con 12° de inclinación al N. E., y contienen restos fósiles mal conservados que parecen ser de ostreidos. En los criaderos de ónix algunas de las calizas son cristalinas y se presentan acompañadas de tobas calizas y travertinos.

En la sierra de Juárez existen depósitos aluviales auríferos en los campos de Juárez, Los Pinos y Campo Nacional y en las depresiones de la sierra de San Pedro Mártir se encuentran depósitos recientes de acarreo, generalmente de corto espesor, formados por arenas gruesas, procedentes de la desintegración de los granitos y en los cuales abundan las laminitas pequeñas de mica.

El Combustible en los Reverberos de la Fundición Cuprífera.

El el Boletín de Agosto de la A. I. M. E. viene un trabajo escrito por el Sr. C. D. Demond respecto al trabajo experimental de la fundición en hornos de reverbero. Los resultados obtenidos en Anaconda con varios combustibles se hallan descritos minuciosamente en dicho trabajo llegando a la conclusión de ser cuatro los factores encontrados que afectan la eficiencia de la fundición del cobre, y son 1°, el estado de la verdadera substancia del carbón; 2°, el porcentaje de polvo; 3°, el porcentaje de humedad y 4° el caráter y porcentaje de las cenizas.

Al juzgar el carácter del carbón basado en análisis aproximados deberá tenerse un gran cuidado, porque las cifras pueden ser muy engañadoras con relación al radio del carbón fijo a la materia volátil en el verdadero carbón, no pudiendo decirse nada respecto a la composición y calidad de dicha materia volátil. El carbón que da una llama amarillo-opaco o una llama blanca debido a las partículas incandescentes es indispensable para el buen éxito en los trabajos de reverbero. Una flama excesivamente densa o humeante no es de desearse; y con carbones que no arden bien en el tiro natural podrán mejorarse estos notablemente, forzando dicho tiro.

Los resultados del horno están directamente afectos por la cantidad de polvo contenido en el carbón decreciendo el radio de la carga fundida con relación al aumento del polvo contenido. La mejor solución a este problema del polvo fino es la de pulverizar todo el carbón y quemarlo insuflándolo directamente al horno. Esta práctica parece que se ha generalizado mucho, pues ha sido adoptada en muchas plantas.

La humedad en el carbón necesita de calor para su evaporación, y por consecuencia hace que descienda la temperatura del horno. La reducción del porcentaje del margen sobre la temperatura crítica reduce la capacidad y economía de la operación de fundición. Las cenizas también reducen el valor del carbón; pero tienen un valor relativo, porque evitan la excesiva pérdida de combustible a través de las parrillas. En algunos casos no obstante, las cenizas pueden escorificarse de tal manera que frecuentemente llegan a obstruir las parrillas perjudicando la combustión. Muy raras veces es posible predecir por el análisis de las cenizas cuáles serán las potencias escorificantes de ellas.

Otro de los factores que afectan la eficacia de la fundición en reverbero precalentando la carga y el aire es el fundente de la carga.

Mezclando fundente de piedra de cal con el calcinado antes de cargar el reverbero en lugar de cargar el calcinado y el fundente por separado ha resultado un aumento de 144 toneladas fundidas con 46 toneladas de carbón contra 163 toneladas fundidas con sólo 48 toneladas de carbón. Cargando la mixtura de calcinado caliente, también resulta un aumento en la economía. Calentando previamente el aire en aparatos perfeccionados ha dado por resultado en algunos casos el aumento en la capacidad del horno en un 50 por ciento sobre los obtenidos con aire frío. La producción de vapor con el calor perdido de los reverberos de Anaconda viene a ser como el 25 por ciento de la suma total de calor del efectivo de todo el carbón; mientras que únicamente el 15 por ciento se utiliza actualmente para la fundición. La fuerza así desarrollada de ocho hornos monta a 30 por ciento de los 16,700 caballos de fuerza mecánica usados en toda la fundición y planta de concentrar.

Para encontrar el diámetro que debe tener el cilindro de una bomba que deba mover determinada cantidad de agua por minuto, (siendo de 100 pies la velocidad que se considera como reglamentaria en el pistón), divídase por cuatro el número de galones de agua; al cociente extráigasele raíz cuadrada, y ésta será el diámetro en pulgadas del cilindro que debe tener la bomba.

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The New Tax on Mines.

The new decree imposing a sliding-scale rate on mining property, making a minor increase on the minimum area of ground held and rising with the number of pertenencias, will bear heavily on those companies which hold large tracts bringing in no revenue. Under the old law it was comparatively inexpensive to denounce and hold large blocks of pertenencias on speculation, leaving the ground undeveloped until a buyer with the right price could be found. The old laws seemed to favor the formation of huge holdings of mining as well as agricultural lands, holdings which could be held through long periods of time. The improvement of adjoining properties enhanced the value of these holdings, when it became an easy matter to cash in the unearned increment. There have undoubtedly been many abuses of this kind in the past. Tracts of mining land have been held in all parts of the republic, not with the intention of opening mines, but merely with the expectation that some one else would make a strike in the neighborhood, when a profitable sale would become possible without any exertion on the part of the holder.

If it is the purpose of the new law to break up these large speculative holdings, its success is already assured. Already there is a great cutting down of the number of pertenencias held. A company operating, even on a small scale, will not find it unduly burdensome to pay its taxes on 25 or even 50 pertenencias, but those who are not producing at all are finding their hundreds and even thousands of pertenencias too much of a burden to carry under the new arrangement. The first result of the law will be to throw numbers of properties open to denouncement.

Experience alone can prove the success or failure of the new law as a revenue producer. That will depend largely upon the rate of increase along the sliding scale. If the difference between the burden of the small holding and that of the large is too drastic, the large holdings will disappear and the burden will fall upon the small tracts alone. In any case legitimate mining operations do not require immense tracts of land. The net increase, even on small holdings, is considerable, but the industry must expect to bear increased taxation, and it is better to let a part of the burden fall upon superfluous holdings rather than to place the entire load upon equipment and production.

Magmatic Waters.

Most practical mining men have watched with a mild and amused interest the long and somewhat heated controversy among the geologists about the relative merits of meteoric waters and waters of vol-

canic origin as collectors of vein-filling material. The old saying, "You find the ore where you find it," still holds good in minds which have been so fully occupied with the practical that anything theoretical is accepted only with grave suspicion. Nevertheless the geologists have been of great help to the practical miner, for in looking for ore it is well to have some idea as to where ore is likely to be found and where a search would be hopeless, even though the idea is based on purely theoretical grounds.

The question whether our deposits have been dissolved and brought to the vein exclusively by rain water or collected and deposited from water from within the rocks is also of the greatest practical importance. Obviously if we admit that all vein filling is the work of rain which seeps in from the top of the ground we can not expect much ore very far from the surface. It is much more pleasant to think that some bodies at least, have been formed independent of surface conditions, and it is also easier to believe that our veins are the work of the richly charged "juices" squeezed out of molten mases of rock by heat and pressure.

Elsewhere in the present issue appears Prof. J. F. Kemp's latest contribution on the subject. Prof. Kemp has been one of the leaders in the controversy, which has often been obscured by alarming technical terms and phrases. He here presents a review of all that seems worth while remembering of the discussion which has raged over many years, and he does it in a characteristically clear way, almost entirely free from technical frills. If any of our readers are still in doubt as to what it is all about, here is an explanation which it is a pleasure to read.

Progress in Electrometallurgy.

While we have been busy trying to keep track of the recent rapid changes in cyanide practice, the men who use electric current in the treatment of ores and metals have been making surprising progress. It seems that it is now actually possible to make pig iron in the electric furnace in competition with the blast furnace, which has in the past twenty years been developed into a marvel of economy and efficiency. To be sure the localities in Norway where this is possible are especially favored by cheap water power and electric current, but blast furnaces are also located in favored spots within easy reach of supplies of ore and coal. For making certain special steels the electric furnace has already entirely replaced the coal and gas fired furnace, and it seems that for making ordinary steel the electric furnace offers certain economic advantages. We have long known that these things were possible. A high, easily controlled temperature without contaminating gases is ideal for many metallurgical operations. The surprise is that it can be done and that, at the same time, it can be made to pay.

The amazing growth of the aluminum industry is another thing that is apt to escape our attention. A few years ago it was supposed that this metal had about reached the limit of its use, and that the makers were trying to make a market for it where it did not properly belong. Now aluminum is recognized as a rival of copper in many ways, and while the output of copper is not increasing, that of aluminum is doubling nearly every year. Last year's production in the United States exceeded 60,000 tons, and in use aluminum replaces more that three times its own weight of copper. Aluminum is no longer a curiosity and before long we may expect to see a trade nickname to take the place of its present rather unhandy scientific title.

Another triumphs of electrometallurgy is the production of metals unknown to the older metallurgy, metals for which markets and uses must be found. Electrometallurgy seems to have emerged from its period of quackery, the period of marvellous claims, great promises and non-fulfillment. Electricity and chemistry seem to lend themselves easily to the schemes of the quacks. Why, it is difficult to explain. It is a pleasure to see that metallurgy is, in a measure, rid of the electrical quack. The chemical quack is still rampant.

The Inevitable Error in Sampling.

In the old days when mill returns failed to check with the mine sampling the blame was simply laid upon the assayer. For this reason, assayers as a class, like politicians, still live and move under a cloud of suspicios. Now that the dificulties of sampling are better understood and it is well known that a fairly accurate assay is a simple matter compared with the taking of a decently representative sample, there should be less friction between the mining and milling departments. While both sampling and assaying are merely approximations, which can never by chance be entirely accurate, the chances for error are much greater in sampling than in determining the quantity of metal in the chosen sample by assay.

There are certain necessary assumptions in sampling that make error inevitable, for no ore can fulfill all the requirements of those assumptions. The theory of sampling assumes an amount of uniformity of material and continuity of value that is never met in practice. Approximate uniformity and continuity is secured by continued grinding and mixing, but neither of these processes can equalize differences of specific gravity, and distribution by mixing is purely a matter of chance. Where there is much difference in specific gravity, some segregation occurs, even with the most careful handling. The slightest movement or jar may send a particle of gold down to a lower layer through lighter particles of other minerals. With certain gold ores it is impossible to cut samples, even from small lots containing only a few kilos, and be certain that these samples will check within five per cent.

All of the difficulties enumerated above are encountered after the lot of material has been properly dried

and placed upon a clean sheet-iron floor. Sampling of ore in place has an additional set of difficulties. Lack of uniformity of the ore in a mine may be so great that it is useless to sample the mine at all, that is, with a view to gaining an estimate of the total value. Without sampling of some kind there would, of course, be no mining. In some mines the values are so unevenly distributed that no number of cuts, no matter how carefull placed, can give a fair estimate of the value of the block. In cases of this kind the only indication of value that can be obtained is whether the material in any given spot is of milling quality or not.

The chief obstacle in sampling more uniform de-deposits seems to be the difference in friability of the minerals. If the gangue is tough quartz and the minerals carryng the values soft, like argentite or ruby silver, the the sample will almost invariably give a higher value than the actual, due to the breaking down from the sides of the hole or cut and dribbling into the sample of an undue proportion of the more easily broken mineral. This is so well known that engineers commonly use a factor for reducing the total estimate. But this factor must necessarily vary greatly with the character of the deposit. In the case of South African banket, the mill yield plus tailing content is from six to fifteen per cent. below the average indicated by sampling. In the lead mines of Australia the difference is at least ten per cent. Sampling of several gold mines in different parts of the world gave results showing a difference of twelve per cent. Low results from mill returns may often be caused by the entrance of waste in the mill bin, but this alone is not sufficient to account for all the differences between mine and mill estimates.

Mining Solid Native Copper.

Stories of enormous masses of copper were common in the early days of the Lake Superior district. Several masses of this kind have been found and it frequently required great ingenuity to get them out to the surface. The occurrence of these masses is not limited to the levels near the surface. Recently a mass of this kind has been found between the twenty-fifth and twenty-seventh levels of the Trimountain mine, belonging to the Copper Range Consolidated group. It was first discovered at a point above the former level and has been traced for more than 300 feet with no indication of its coming to an end. It is roughly in sheet form, the average width being about 10 feet, and the thickness from six to eight inches. This single mass promises to yield several thousand tons. The difficulty in mining these masses lies in breaking them up into sizes which can be handled. At the Trimountain the mass is being cut up by means of air-driven chisels, two men being continually at work on it. While this newly discovered mass is unusually large, it is not believed that is will reach the record. A similar mass of pure copper was found at the Calumet & Hecla, it extended for 800 feet on the dip. One found in the Ahmeek reached from the surface to the sixteenth level.

Colonel Tepetate.

"How do you understand this' Safety first,' thing?" inquired the Pessimist. "Do they mean safety before everything, before profits, for instance?"

Colonel Tepetate smiled. "Hardly that, I should think. You know, profits must remain supreme, for without a return on the money there would be no industry. That is something our socialistic friends do not always bear in mind. Whatever we may do or give up, we must continue to figure on profit in everything here below. 'For what shall it profit a man, though he gain the whole world and lose his own soul.' You see, even in that extreme case, the main question was one of profit."

"Perhaps, then, they mean safety before efficiency."

"I'm afraid that's not quite the idea either. I do not think anybody has figured on giving up much efficiency for the sake of safety. The loudest claim of the safety people is that it increases efficiency. All safety devices are supposed to facilitate the work. Otherwise nobody would have anything to do with them."

"Then, what do they mean?"

"Oh, it's a good enough slogan for the greater-regard-for-human-life movement, which has been the chief job of the U. S. Bureau of Mines for several years. It doesn't sound very good, and the idea is rather vague, but it seems to serve a purpose. Perhaps they should have consulted T. A. Rickard, or some other 'accuracy of expression' expert, before they adopted it. Anyhow it conveys some sense of advice or warning. I suppose the idea is that one should think of safety first when anything happens; but that won't hold water either, for if one were to think of safety first he wouldn't go into a mine at all."

"What's it all about?"

The old man settled down into a more comfortable pose. "As near as I can figure it out, "he said," the movement is a reaction against the American worship of the machine. The introduction of mechanical power and the substitution of machinery for hand labor, has carried with it this attitude of mind. If a machine can produce as many nails in a day as a hundred men working by hand, in the shop that machine is taken be to worth a hundred men. Besides, the nails were better than the handmade lumps. Quite naturally the manufacturers thought that all they needed was a lot of fine machinery and a manager who could keep the wheels going round. To be sure, some men were needed to act as attendants on the machines, just as a racehorse has to have a certain number of grooms. Almost anybody can rub down a horse or pour oil into a cup; so these necessary supernumeraries were picked up anywhere, and got little respect. If a groom is fool enough to get in the way and get his fool skull cracked, that is his own affair. Drag him out and hire another! You see, the man doesn't run a mile in 1:40, nor does he turn out 128 nails a minute."

"What was the result?"

"The result was that the railroads, the steel mills

and the coal mines in the United States killed and crippled more men in a year than a fair sized war would have done. A steel mill, which I as a boy regarded as the most wonderful place on earth, averaged eight accidents per week, and I have myself seen six badly wounded lying under the eaves of the machine shop at one time. There was not a family in the community that had not lost one or more members in that mill. Bill, seventeen, had been caught by the beam of a Bessemer blowing engine; a crane had slipped and dropped a hot ingot on Henry; he lived two hours-and so on. Every family had paid its toll to the mill, and the town where the employees lived was contemptuously known as, The Patch. That was twenty-five years ago. That mill was designed and built by Alexander Holley, our great metallurgist who has a statue in Washington Square, New York."

"They do things better now."

The old gentleman shook his head. "There is still a long, long way to go," he said "There is now more willingness to admit that the man is more important than the machine, and that he should be selected and treated with the same care. But the trouble is that it is hard to prove that safety appliances will net a profit, and the original outlay is often considerable. There is, too ,still plenty of contempt for this humanitarianism among engineers who pride themselves on being practical."

"In what way?"

"I know an engineer who will not protect a third rail, because, he says, it is the business of the men to know that it is loaded. He argues that we do not build fences to keep people from falling into the river. They know the river is there, and it should be the same way with a third rail. Most mines and mills are arranged on that principle. How many safety stops do you see at shaft stations and how many protected gears around tube-mills? In most cyanide mills, the shift boss takes his life in his hands at least once every 24 hours—high trestles without railings, exposed gears everywhere, no protection against heavy duty belts liable to fly off at any moment and whip someone into eternity. These surround him at every turn, and if he is slow in getting around, he gets fired."

"After all, proper care on the part of the men is the best protection."

"True enough! But there are certain dangerous occupations that demand a sort of contempt for danger, and the most valued workmen are the most reckless. What shift-boss has not saved one or more lives by holding back reckless fellows who wanted to rush in and set things right?"

"In this country that is the boss's main worry, to keep his men from getting hurt."

"Ah! This country," sighed the old man. "The cheapest thing in Mexico is human life. Some years ago a company lost an entire shift in a mine, 170-odd men, and it cost that company exactly 1500 pesos for a common monument, not a cent for pensions or damages. Within the past two years I have seen a mine manned almost entirely by boys of eighteen or twenty. There are no older men; they all die off from lung disease. Some of the miners from that district have, no doubt prolonged their lives by joining one or another of the revolutionary armies. In this country nobody has even begun to think of the welfare of the Indian laborer."

"How about Europe?"

"In Europe they have made it more expensive to kill men in the shops and mines, and so accidents are not so common. Something of the same sort will have to be done in the States and—and here. But Europe is a rather poor example just now. While American industries manufacture about 15,000 widows and 45,000 orphans every year, Europe is making several millions in a much more foolish and efficient way."

"They ought to apply 'safety first' to war."

"They do as far as they can. In fact war has more regard for human life than the mining and metallurgical industries. But war is one of those industries which require a certain amount of waste. If our mines and mills were so well organized for safety as, say, the armies of Europe, the number of industrial fatalities would not average one for every sixteen minutes, day and night, as they do now in the States."

"And in Mexico?"

The old man threw up his hands. "What can you expect in a country where life is so excessively cheap? A friend of mine recently returned after several weeks travel on troop trains. The roads were mostly rough and dangerous for lack of ties. On one occasion a woman fell out of a box-car and the wheels cut off one of her arms. The train stopped a moment to see what was the matter, and then—went on, leaving the poor creature weltering in her blood besides the rails in the desert."

Effect of Air in Zinc-Dust Precipitation.

In precipitating from cyanide solutions by means of zinc dust, the admission of air to the precipitation line and presses must be carefully avoided. Upon starting one Arizona mill there was absolutely no precipitation when the solution was pumped through the presses. The pressure rose to over 25 lb., with the presses handling but 50 per cent. of their capacity. A careful examination at the precipitate pump showed that the zinc-feed pipe entered the solution line between the pump and the pregnant sump, permitting a large volume of air to enter the pipe line and press. Upon correcting the piping arrangement there was on further trouble.

Another Arizona plant found that the effluent solution from the precipitation presses instead of being barren was actually 200 to 300 per cent. richer than the solution in the pregnant sump. A careful examination showed that at times the pregant solution sump was being pumped dry, allowing large volumes of air to enter the precipitation system, and re-solution was taking place.

Use of the Brunton in Mine Surveying.

(Written for the Mexican Mining Journal)

By James O. Greenan.*

In many mines it is the common practice to run all connections with the transit. This is the case whether the connection is a raise, drift or croscut, and in some mines even the stopes are measured with the transit. It is the purpose of this article to point out the surprisingly accurate results that are obtainable by the Brunton type of hand-transit, in places adapted to its use. This, of course, excludes localities where iron deposits cause an erratic behavior of the magnetic needle.

At the Nevada Hills mine, fully ninety per cent of the surveying is done with the Brunton. The transit is used, once a month, in the drifts and crosscuts only, as a check on the Brunton work, and the check is usually a matter of inches. Raises are invariably run with the Brunton, and the connections thus far have been, to all practical purposes, perfect. For instance, a 175-ft, raise, with several bends in; was recently driven from the 800 to the 650-ft. level. The connection was made on the side of the drift, to avoid disturbing the track, in exactly the spot desired, and the Brunton tie between transit stations on the two levels checked withn 1.8 feet.

Recently the writer had occasion to make a preliminary survey of a property which was being examined for purchase. The group surveyed consisted of eight claims, with a range of elevation of 1300 ft., and a maximum horizontal distance of 5000 ft. One inclined shaft was 267 ft. deep, with 1270 ft. of workings from it; there were nine other shafts, and 1800 ft. of tunnels, beside numerous open cuts, outcrops, etc., which were tied in. The work necessitated 207 set-ups, with 275 shots, and a total of 21,500 ft. of traverse. The Brunton and a 100-ft. cloth tape were used, the latter being undoubtedly a source of considerable error and delay. The two traverses checked within eight feet, which was well within the limits of the accuracy of the claim corners, as they had not been surveyed for patent, and the final map checked with a previous transit survey of part of the property, except in one place, where a gross error in the transit survey was discovered. It took two men two and half days to do this work, while, with a transit, it would probably have taken at least ten days.

Precautions.

Certain precautions are, however, essential for accurate work with the Brunton. First, as to the instrument itself the needle should at all times be "lively." When the point on which the needle is balanced becames worn, the needle becomes sluggish in its movements, and is apt to stick, thus giving a false reading. On some types of hand-transit, the bubble-tube is not integral with the swinging arm. This is an undesirable feature, as a slight loosening of the screw which holds the tube to the arm may allow the tube to swing slightly, giving a false value of the vertical angle. The arm should be set at zero, and the bubble tube be tested for horizontal, at frequent intervals.

The recent Bruntons are equipped with two bubble-tubes at right angles to each other, for assistance in leveling the instrument in both directions. This is a desirable, though not essential feature, as a little practice enables the observer to tell whether or not the instrument is level by the behavior of the needle. Some Bruntons are graduated clockwise from 0° to 360°, while others are graduated both ways to 90° from the north and south points. The advantage of the former method is that it is practically impossible to make a mistake in reading the quadrant, while its disadvantage lies in the fact that there is a possiblity of error in the mental subtraction that is necessary for every reading except those in the northwest quadrant. Conversely, the latter system has the advantage of always giving a direct reading, while it is necessary to use care in recording the correct quadrant when the bearing is near any of the four cardinal points. Personally, the writer prefers the latter method.

It is desirable to have an auxiliary graduation for 30° east and west of the north point on the outer edge of the movable ring on which the main graduation are inscribed, to facilitate a more accurate setting-off the magnetic variation. Care should be taken to change this setting for different localities. The writer has in mind an engineer who negkected this precaution, the result being a constant error of three degrees in all his readings about a certain property.

The new form of Brunton, in which the peep-hole for vertical angles is in the form of the outline of a figure eight, is a great improvement over the small, oval peep-hole. In this connection, it may be mentioned that there seems to be a greater chance for error in measuring vertical angles than in reading bearings. Readings on the vertical circle should always be checked at least once.

Needle Variations.

Perhaps the most fruitful source of error in underground work is the proximity of air pipes, track, machines, steel, or anything which tends to exert a local attraction on the needle. No hard and fast rule can be laid down as to the distance at which this attraction will affect the needle; neither is it safe to depend on the erratic behavior of the needle to indicate the fact that there is a local attraction, for it is frequently the case that an apparently perfectly normal reading will be obtained even when some magnetic object is causing a strong deflection. Bearings of any importance should be read from both ends of the line, and the check should be within ½°. If they fail to check, readings should be taken from various intermediate points, and an average taken, rejecting erratic readings. The average of two readings taken from the half-way point to both ends of the lime will usually be found correct.

The surveyor should take care that there are no objects about his clothing which could affect the needle, such as a carbide lamp, candlestick, knife in the pocket, belt-buckle, metallic buttons, and even hobnails on shoes. The mention of some of these may seem absurd, but they all have been the cause of erroneous readings within the writer's own experience. Once the writer was much puzzled by the erratic behavior of

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the needle when apparently all precautions were being observed. It finally dawned on him that the rings of his loose-leaf note-book, which he had tucked in his belt, were responsible for the error.

Hints from Practice.

Practice is, of course, necessary for the rapid and accurate handling of a Brunton. The suggestion in Wm. Ainsworth and Sons' excellent pamphlet on the Brunton are all of value particularly their advice to learn to use the instrument close to the body, while standing, and to swing the body from the hips, in order to change the line of sight. When getting the bearing between two points of unequal elevation, it is usually better to shoot from the lower. When, however, it is desirable to shoot from the higher point, and the vertical angle is over 15°, the instrument should be turned with the mirror away from the observer, and the point lined through the peep-hole. Many surveyors do not use this method, on account of its apparent inconvenience, but it can readily be learned, and will prove of great value.

When the vertical angle is over 60°, it is difficult to get and accurate dearing directly, even by his methods.

When possible —as in the case of a steep raise— it is best to take a bearing at a comparatively small vertical angle to a point on the footwall and then plumb up, repeating if necessary.

A leather case, attached to the belt, is the most convenient manner of carrying the Brunton, as a shoulder strap is a nuisance underground. A carbide lamp, worn on the hat, furnishes an excellent light for Brunton work. A hat lamp is almost a necessity for vertical angles.

The advantages of the Brunton over the ordinary transit may be summed up as follows:—

First—its extreme portability. The Brunton can be carried in the pocket or in a belt case, while a transit must be carried carefully in the arms or on the shoulder. The writer once dropped his Brunton fifty feet down a stope with no apparent ill effects; the results of a similar drop on a transit would be apparent, to say the least.

Second—the Brunton needs no adjustments. The transit has several adjustments, which must be watched constantly.

Third—the Brunton can be "set up" in places impossible for the transit.

Fourth—much more rapid work can be done with the Brunton.

Fifth—the first cost of a Brunton is from one twentieth one thirtieth that of a transit.

These advantages, striking as they are, are completely offset by the transit's advantage of absolute accuracy. This, of course, leaves it alone in its field for that class of work. The fact remains that, in many mines, an expensive transit is regularly taken into places difficult of access, in order to run ordinary mine connections. The instrument is endangered, and an undue amount of time used, while with a Brunton an equally good connection could be made, without any danger to the instrument, and with a saving of many hours of the surveyor's time.

Recent Developments in the Use of Electricity in Metallurgy.

Electrometallurgy has as yet found little application in Mexico, but in view of the abundant water power available and the many natural advantages of the country, it seems certain that in the future electric energy will play a part of increasing importance in the growth of the mineral industry. The following abstract from an address delivered by Prof. Jos. W. Richards before the Engineers Club of Philadelphia, gives a general review of the present status of electrometallurgy:

One definition of metallurgy is: "The art of making money out of ores." The technical definition is: " The art of extracting metals out of ores and refining them to the purity required by every-day use." Metallurgy is a part of applied chemistry. Metallurgical operations are mostly chemical operations. Ores, with few exceptions, contain the metals as compounds and not in their native state. Therefore it is usually a matter of decomposing the compound, as easily and cheaply as it can be done, by means of chemical reagents. Electrometallurgy is the art of utilizing the electric current in obtaining metals from their ores, or in refining them for industrial purposes.

Electric current can be utilized for electrolytically decomposing chemical compounds. The electro-thermal method is that in which the current is used for its heating power only, and in which some other agent does the decomposing. These two are very distinct from each other, and I will spend a few minutes in emphasizing the difference between them.

In the electrolytic method you depend upon the electrolytic decomposing power of the current. You necessarily have to use a direct current except where the electri cell itself rectifies the current, which is very exceptional. In all practical electrolytic operation, only direct current is used.

In electro-thermal work, where the current is used for its heating power only, direct current or alternating current may be used. Alternating current is cheaper and does not give the indirect effects that a direct current will give, for with direct current in an electric furnace you usually have undesired one-sided effects at the electrodes.

Electrolytic and Electrothermal Processes.

In the electrolytic furnace the amount of useful work done, as measured by the amount of the product, is proportional to the amperes of the current which pass, according to the laws discoverd by Faraday. When you are passing a current through an electrolytic cell, the amount of product is independent of the volts which may be expended on the cell, and is dependent only upon the amperes. It is only secondarily that the volts used affect the amount of product which can be obtained by forcing through more amperes. It is easy to calculate the theoretical amount which you should get at 100 per cent. ampere efficiency upon the amperes flowing through any electrolytic cell.

In electro-thermal work the heat energy of the current is that which is utilized, and the heat effect is proportional to the amperes multiplied by the volts, so that the product will be proportional to and deter-

mined by the amount of energy which is expended upon the furnace as measured by the K. W. H. meter. The two processes are thus seen to be essential distinct in these two fundamental ways. A third distinction may also be drawn between them: that in the electrolytic apparatus you must have an anode and a cathode arranged for proper electrolysis, and proper arrangements for the escape of the gaseous products at the anode and the collecting of the products at the cathode. In the electro-thermal methods you have no such distinction of parts. There may be electrodes, or the terminals or poles, but they are not positive and negative, they are not anode and cathode, and there is no arrangement of the cell which copies or duplicates the electrolytic arrangement which is necessarily part of an electrolytic operation.

I will discuss now why the electrolysis of fused salts is sometimes classed erroneously under the electric furnace methods. Fused salts generally conduct current freely. Their order of resistivity is that of a well-conducting aqueous solution like the best conducting sulphuric acid, something like one to there ohms per centimeter cube. When you pass the current through and decompose fused salts, the operation is primarily electrolytic—the decomposition of a fused salt to obtain its ingredients. However, you cannot pass an electric current through any solution or, in fact, through any material without generating some heat by the passage of the current. If you electrolyze with an intense current you generate much heat, and you may reach a point where the internal heat generated by the passage of the current is so large as to keep the electrolyte melted without the assistance of the external heat with which you started the operation.

By running the operation with an intense current, it is possible to get the salt melted and keep it so without the aid of electrolysis, thus incidentally generating enough heat to keep the salt liquid at the temperature at which you run, 300, 400, or 1000° such as when producing aluminum, etc. And by regulating the current you can keep the temperature just at the desired point. Many writers have been muddled on this point, and have thought that when outside heat is dispensed with you then have a furnace, and they have classed these with electric furnace processes. That is taking them away from where they properly belong. The fact that the operation is essentiallly electrolytic is not affected by the fact that the heat generated partly suffices to keep the bath melted, and whether the heat generated keeps the bath melted or whether you have even to cool it down, that does affect the classification; it is not an electric furnace process. I would ask you, when you read about electrometallurgical processes, that you will bear that in mind that the electrolysis of fused salt, when current supply is sufficient to keep it fused, is necessarily an electrolytic operation. Some people think that when you are conducting an operation requiring a higher temperature than the ordinary one, you necessarily have an electric furnace. This difficulty has been solved by using the term "electrolytic furnace" for an operation of this kind, where the electric current performs electrolysis and also supplies all the heat necessary to keep the salt melted.

Principles of Electrolysis.

Taking up now the different methods of electrometallurgy, starting with the use of aqueous solution among the electrolytic methods, when the only source of electric current was the battery, the plating of silver, brass, etc., and other metals, by means of an aqueous solution and electric current, was the only branch developed. The Elkington Brothers in England were the best-known platers of gold, silver, and other metals, using aqueous solutions to do electroplating. According to my definition, electroplating with pure metal used as an anode would not be included in electrometallurgy, and I should say at the present time, that electroplating with a pure metallic anode is not an electrometallurgical operation in the strict sense. I mention this because in the early days, when the battery only was used as a source of current, electroplating was called electrometallurgy. In Mr. Shaw's first book, he assumes that electrometallurgy means nothing more than the plating of the metals, the duplicating of medals and coins, starting with a pure metal as anode, and simply changing its form and plating it over.

From the old books up to the present you will find much in them about electroplating or, in general, galvanoplastics, the art of changing the form of a metal. Elkington Brothers, who were plating gold and silver, were the first to utilize this principle for refining copper, away back about 1865. When the first dynamo was invented—the first machine of Wilde—there arose the possibility of using impure copper as an anode and plating out pure copper, thus saving all the gold and silver contained in the impure copper. That was the first process by which it was possible to extract gold and silver from the metallic copper when they were present in very small amounts, and the process owed its commercial success to treating cheap impure copper, saving the gold and silver, and at the same time obtaining a very pure copper at the cathode. This is a real electrometallurgical operation. It has a few fundamental principles which I will set forth as concisely as I can.

To electrolytically refine impure metal, you must choose as electrolyte a soluble salt in solution, such that the actual metal you desire to get will go into the solution, and then you must use a depositing current of such quality and quantity that you deposit only the desired metal out of solution. When you take impure copper as anode and thus electrolyze it, there remain undissolved, at the anode, the gold, the silver, the platinum, little specks of slag and matte, and particles of copper, which drop to the bottom. This anode mud will frequently be 50 per cent. copper and 30 or 40 per cent, silver and gold. The iron, nickel, zinc, cobalt, tin, and a number of other metals have gone into the solution. The current density at the cathode must be high enough to deposit the copper but low enough to let the impurities accumulate in the solution, whence they have to be removed by other means.

Those principles are the foundation of the entire copper refining industry, by means of which about 900,000,000 pounds of copper per year are refined for use in this country, the value running over one hundred millions of dollars. Similar principles are used for refining lead. For instance, Dr. Keith, of Philadelphia, worked out a very satisfactory laboratory process for refining lead many years ago. It was not satisfactory commercially, however; but in later years the problem has been solved by Mr. Anson G. Betts, and there are two or three such plants in operation in this country and abroad giving us a lead of very high purity free from silver and gold, and particularly free from bismuth, which is one of the most difficult elements to get out of lead by ordinary refining processes. Bismuth remains behind in the slimes in such shape that it can be purified, and this process has increased very greatly the output of bismuth in this country. The lead is so free from bismuth that it commands a high price, being particularly desirable in the manufacture of white lead, for a trace of bismuth in white lead spoils its color.

Another element which is being electrolytically refined is zinc, which is more difficult to refine than cop-

per or lead. There is also less margin commercially than there is for refining copper, and there is no gold or silver in it whose saving pays for part of the operation, so the refining of it is not as profitable as that of copper.

The electrolytic refining of silver was first made practicable by Moebius. Taking as anode the silver bullion which comes from the cupellation furnace, the silver, copper, and iron go into solution, while the gold and platinum remaining are not dissolved; by properly regulating the depositing current, only pure silver is deposited. Silver of the greatest commercial purity is made in this way.

Gold is electrolytically refined on the same general principles, but with differences in detail, by the Wohlwill process. The process was worked out at the Deutsche Gold und Silber scheide Anstalt in Hamburg. A solution of chloride of gold, electrolyzed with a sheet of gold as anode, gives off chlorine into the air, and the anode is not dissolved. If you add hydrochloric acid to that solution, making a strongly acid solution, there comes a point where the escape of chlorine gets less and less, until its escape is prevented altogether and the gold anode dissolves perfectly. That process was first put into operation in America at our Philadelphia Mint; I believe the electrolytic plant has since been moved to the assay office in New York. The gold, platinum, and copper go into solution, while the silver forms chloride and remains undissolved. By using a proper depositing current, pure gold is obtained. The gold beaters say they are getting much better results now from this commercial gold, because it is better than they were able to procure before by the acid chemical processes. The platinum is recovered from solution by a simple chemical operation, so that the platinum that used to stay with the gold and be lost is now saved.

Insoluble Anodes.

Besides tin, lead, silver, copper, and gold, I believe there are other metals to which the electrolytic refining process is quite applicable. This is a large field in which electrometallurgists are already working; antimony and tin, for instance, have been worked on in this way. The general principles explained are applied, with differences in detail, to each one of the metals, enabling one to obtain the purest metals that have ever been put on the market.

If you electrolyze a solution with an insoluble anode, you can extract the metal from the solution without replacing it by metal from the anode. There are a number of promising electrometallurgical processes included in this class of electrolytic process.

When you dissolve the gold from gold ore in potassium cyanide solution, the next problem is to get it out of solution. The way this is usually done is by chemical deposition by means of zinc. The electrometallurgical method of extracting gold out of solution was used by Siemens and Halske, in South Africa, but that method has had a hard struggle to compete with ordinary precipitation by zinc. Silver goes with the gold when it is deposited from a cyanide solution.

If you look at the water in a copper mine, you will find it is frequently colored blue by sulphate of copper. That solution is usually run over scrap iron or pig iron, to deposit the copper by a chemical reaction; but if you are handling solutions where iron is not available it is possible to electrolyze it with an insoluble anode and throw down the copper quite pure on the cathode.

This year we have had news in the technical press of a very great development in this method of working in Chile. The Guggenheim's Chile Explotation Company has uncovered a large deposit of copper ore near Antofagasta which is soluble in dilute sulphuric acid. The ore is treated by dilute sulphuric acid, and, by electrolyzing the solution by insoluble anodes, the sulphuric acid for further treatment is regained The main crux of that question was to find an insoluble anode which would not be attacked. Lead was used, but it forms lead peroxid, and gradually falls to pieces; a high-silicon iron was used, but that gradually falls to pieces. In Germany they are now casting magnetic oxide of iron, Fe_3O_4, into the shape of anodes and using them sucessfully. They are about the shape of flattened baseball bats, hollow inside, with the walls a little over one-fourth inch thick. They are made in Frankfort-on-Main by the Griesheim Elektron Company. The Chile Exploration Company gave the Frankfor firm one order for 90,000 of these electodes. It is interesting to consider that when they are immersed in the solution, the magnetite itself not being a good conductor, you would have considerable resistance in passing current down to the lower end. This is obviated by electrodepositing a shell of copper on the inside surface, fastening copper strips at the top to conduct the current into the inside shell, and then the only resistance which the current meets is about one-fourth inch of the magnetite to get from the inside to the outside. This work was described by E. A. Capellin Smith in New York before the American Electrochemical Society, at its twenty-fifth general meeting in April last. That was the first public description of the operations in detail. That plant is designed to treat 6000 tons of ore a day. An immense body of ore is be treated by this method.

You can get an idea of the importance of these methods of electrolysis with insoluble anodes from the few instances given. These magnetite anodes may also be quite useful in other electrolytic processes. In the generation of oxygen, for instances, they may find it practicable, for there has been trouble with anodes becoming corroded. I saw last summer, in Butte, an operation of the same kind, of the Butte and Duluth Company, plating copper out from sulphate solution and regaining the sulphuric acid for use again. The Phelps Dodge Company, which runs large copper mines in Arizona, has begun to study this method for its lowest grade of ores, and the main solution of this question rests on the use of insoluble anodes of fused magnetite.

Electrolysis in Fused Salts.

We will next consider the question of the Fused Salts. In nature we find a number of metals in the state of salts which are fusible and which can be electrolyzed—sodium, calcium, and magnesium are obtained directly by the electrolyzation of those simple salts. Common salt, for instance, is only worth a few dollars a ton. If converted into metallic sodium on the one hand and chlorine gas on the other, one worth several hundred dollars per ton and the other worth fifty dollars a ton, you can see there is a great economic gain. The value of the product is out of all proportion to the cost of the raw material, and the cheapest way to do it is electrolytically. We have, therefore, numerous sodium works manufacturing sodium and chlorine from sodium chloride. Sodium fluoride is a stronger salt than sodium chloride and if mixed with the latter is not decomposed by the current because it is a weaker salt. The sodium fluoride keeps the melting point of the bath down and enables them to work it at a lower temperature, and thus get a better return of sodium. The uses for sodium increase greatly as the price goes down. Up to a couple of years ago, sodium makers were using caustic soda, NaOH, costing

about $40 a ton. That was costly and increased the price of the sodium, but by going back to the original sodium chloride and finding electrolytic methods by which it could be utilized the cost of the metal has considerably decreased.

Calcium chloride occurs to a small extent in nature, but should properly be classed as an artificial salt. We have here an interesting illustration of another method of electrolyzing a fused salt. The bath consists of the fused calcium chloride. Calcium is so light that it floats to the surface of the bath, and when it floats it is exposed to the air and is apt to take fire. By putting the cathode just in contact with the upper surface of the electrolyte, the button is deposited against the electrode, and when it reaches a given size the electrode is lifted a little bit. The fused salt sets on it and protects it from the air. By continuing to slowly raise the electrode there is obtained an irregular rod of the metal. You buy the metallic calcium in a stick about one and one-half inches in diameter just as it is drawn away from surface of the electrolyte.

Metallic magnesium is made in a similar way. With a specific gravity of 1.721 it floats to the surface. I have never seen any made in that way, but I hear that the same firm that makes calcium makes metallic magnesium in the same way.

Cerium is used for Welsbach gas mantles, which contain thorium and cerium oxides. The residue from this manufacture is piled up high in the Welsbach Company's yards at Gloucester; it is about half cerium oxide. Dr. Auer von Welsbach started to see if he could not utilize this residue, and he began by studying the properties of metallic cerium, to see what useful properties it migth have. He was impressed by the striking property which it has of giving sparks and found by experiment that by alloying it with iron he could greatly increase the spark-giving property, so as to make it useful in those little cigar-lighters with which we are all familiar. The alloy used in those lighters is made from the waste cerium oxides, dissolved in fused fluorides. It is put into an electrolytic bath in somewhat the same manner as a chloride. The other rare metals (lanthanum, didymium) are allowed to stay in because they do not injure the quality of the alloy.

There is no works manufacturing cerium at the present time in this country, but I visited such a works at Treibach in Austria last year, and I understand that Dr. Fattinger has been over here considering where to put up a plant to manufacture these alloys from the residues which are in the yards at Gloucester, N. J. This industry employs three or four thousand workmen in Austria, and there is no reason why we should not have a similar industriy over here.

I mention zinc here because a great deal of money has been spent in trying to manufacture zinc chloride and then to electrolyze it. The idea is to treat those complex sulphide ores which contain zinc with chlorine gas, converting the zinc into chloride, separating it from the other chlorides, purifying it, and the forming of it a bath, electrolyzing it, and getting back the chlorine, which is used again in the early part of the process. The ores are so complex that the operation has not yet been made a commercial success.

Manufacture of Aluminium.

Electrolysis of solutions in fused baths is a principle which was discovered by Mr. Charles M. Hall and has been the foundation of the whole aluminium industry. It costs considerable money to get pure aluminium, but if you do not get it pure it is useless for many purposes. Mr. Hall was trying to decompose alumina, Al_2O_3, electrically, and he conceived the idea that if he could find some fused salt which would dissolve it the problem might be solved. Cryolite from Greenland is used for that purpose. It looks like wax or ice; its name—"cryolite"—means "ice-stone." It fuses at 1000° C. and when fused it is as limpid or clear as distilled water. Alumina dissolves in it like sugar in water. Take such a solution, put electrodes in, pass the current through, and you get out aluminium.

You have to replenish the alumina as the supply in the bath becomes depleted. This invention of Mr. Hall is the cornerstone of the whole aluminium industry. There is probably 150,000 horsepower being used to manufacture aluminium. The output last year was something like 65,000 metric tons, of wich about 40,000 were manufactured in America. The extent of this infant industry is amazing; it replaces three to four times its weight of the metals with which it is competing, because of its very low specific gravity. The output of copper in this country is now about 500,000 tons a year and is nearly stationery, while the output of aluminium, starting with almost nothing, has been doubling nearly every year. Last year, including Canada, the American output was estimated at 69,000,000 pounds. The commercial importance of this should appeal to us; I believe that aluminium is going to give copper a hard race. There is considerable more margin for reducing the cost of aluminium and selling it at a lower price than there is for copper. When copper gets below eleven cents a pound, many mines have to stop producing, but aluminium can be sold at a profit at a price lower than the cost of one equivalent amount of copper.

Electric Heating Processes.

We now come to the electro-thermal methods and electric furnaces.

The electric funace was first used to fuse metals. There are different kinds of electric furnaces; you can class them broadly into resistance furnaces and arc furnaces. Resistance furnaces can be subdivided into the direct resistance furnace and the induction furnace. The direct resistance furnace is one in which the material is heated directly by the passage of the current through it, while in the induction furnace it is heated by an induced current. In the arc furnace, where you use the arc, there is also some heat generated by the resistance of the electrodes, and some by the passage of current in the materials, where the arc jumps to the materials. The resistance of the arc, however, will account for 75 to 90 per cent. of the heat generated.

The fusion of metals was first tried by Siemens in England. He used a little crucible, making the bottom of his crucible one electrode of his furnace and the other terminal an electrode entering from above. He published his paper before the Institute of Telegraphic Engineers in England, because he could find no other scientific society interested in it. He rigged up a little automatic regulator to keep the arc constant, and his idea was to melt steel directly in the crucible, a crucible full at a time, by electric heat. In some of his tests he obtained about 50 per cent. thermal efficiency for the purpose desired, i. e., the heat in the melted steel was some 50 per cent. of the heat equivalent of the electrolytic energy used. His furnace never went into commercial use, but it was followed some twenty years later by the furnace of Mr. Heroult in the Savoy, France, who was the first to have the idea of fusing steel in a large furnace. Girod also constructed a practicable steel melting electric furnace, and the latter will come into large use as an adjunct to the open-hearth steel furnace and the Bessemer converter.

Mr. Hering's resistance furnace uses small pencil-shaped resistors, filled with molten metal, and transfers the heat generated in them to the molten metal bath. The circulation in and out of these resistors is so active, because of the "pinch" force and its attendant "squirt" effect, that their temperature does not get excessive, and the heat generated in them is rapidly transferred to the main bath. I have seen this furnace working very prettily on brass and cast iron, and I believe it has as promising a future as any electric furnace.

The Stassano furnace is a typical arc radiation furnace. It is usually run by three-phase current, the three arcs being clear of the bath of metal, which is heated by direct radiation from the arc or indirect radiation from the roof. The three electrodes are a little above the surface of the bath, at equal angular distances and with an arc springing between them. But in practice the arc may easily pass to the bath because of the metallic vapors produced in an intense heat like that. The air in the furnace becomes quite conductive from silicon, manganese, and iron vapors, so that you can have a 6-inch arc with about 90 volts across the phases; it is similar to a mercury arc.

Induction Furnaces.

The induction furnaces, of which there are several variations and types, are a great triumph of metallurgical and engineering art. I have the greatest respect for the man who first built a furnace like a tansformer, with only one secondary turn, put a primary right in the centre of that ring, and succeeded in keeping it cool enough so that it did not melt the insulation on the wire, and transmitting the magnetic flux through the intervening space and materials to the metal which was to be melted.

I regard the induction furnace as a marvel of engineering construction, and it was fortunate that it has been taken up by the Germans. It was first worked commercially in Sweden, but was devised years before by Mr. Colby, of Newark, N. J., who tried it but did not make it a commercial success. Mr. Kjillin, in Gysinge, Sweden, did it commercially, and then the Germans took hold of it and stuck to it, improved it, and with their great tenacity have overcome the difficulties and made the induction furnace better than I think any other nation could have made it. Many have thought that the induction furnace would drop out of the race, but the German is coming along with some further improvements all the time. It is better adapted for melting and keeping the steel melted than for refining the steel. It is not very well adapted for refining the steel because of the limited surface exposed. The Germans, however, are overcoming even that difficulty and have arranged a large open bath in the centre of their furnace, a bath in the middle where there is room for the action of the chemicals on the steel for refining it.

Mr. Paul Heroult was the first one to melt steel commercially in an electric furnace. He was not a steel maker; he was an electrical engineer, and he used to say, "I do not know anything about steel, but I am going to learn." I think he succeeded by learning some short cuts. You know we frequently are handicapped by knowing too much about a thing. He made a new flux and used the arc; he used it "without knowing that some things could not be done," and he did them. His furnace was nothing more nor less in outline than an open hearth furnace. His idea was to build a tilting open hearth furnace and to put his two electrodes through the roof above the bath. The idea of putting two arcs in series, with the bath as an intermediate conductor, was novel. Heroult patented the idea of melting steel by two electrodes in an electric furnace, passing the two arcs through a layer of silica slag. Mr. Herolut's furnace has been improved upon or modified by Mr. Girod, who uses only one upper electrode and conducts this lower electrode through the hearth of the furnace, so that he has only one arc, and takes off the current through the one electrode running through the hearth of the furnace. These electrodes in action are partly melted, about half way down, and the rest is solid. They are quite permanent; I have seen some of them which ran eighteen months. The steel metallurgist would be the last to dare to make a hole in the hearth of his furnace and put and electrode through the bottom. But that was where the electrical engineer put it, and there has been no trouble whatever with those electrodes. Right where the electrical engineer put them would have been the last place the metallurgist would put them.

Production of Rare Elements.

Concerning the reduction of compounds to metal in electric furnaces, I have time to pick out only a few characteristic examples.

Boron is one of the rarest metals, but its compounds are abundant. It is made by bringing a volatile boron salt with hydrogen gas into an electric arc, where they are heated to a very high temperature. The salt is reduced by the hydrogen to metal, and the vapors produced are chilled before they have a change to recombine. It is the same operating principle as is used in the fixation of atmospheric nitrogen in Norway. This boron is being put on the market for use in casting "conductivity" copper. This is one of the most recent productions of the electric furnace.

In Niagara Falls, Mr. Tone is reducing ordinary silica sand, SiO_2, to metallic silicon. This gentleman once took me into the carborundum works at Niagara, showed me a barrel containing something, and told me to guess what it was. I made two or three vain guesses, and he finally told me it was silicon, which, he said, "we can make for a few cents a pound." At that time metallic silicon was quoted in commercial price lists at $4.00 a gram. He said he wanted to find some use for it. Silicon is somewhat volatile, and 25 per cent. of that which he puts into his furnace goes up in smoke. He is now making silicon at Niagara Falls by the ton. Silica is mixed with carbon, put into a furnace heated by a carbon resistor, the mixture of silica and carbon being piled around the resistor, and the metal filters down around this resistor and runs something like slag. It is being cast into vessels for use in chemical works. Thus is the most abundant element on earth now commercially available at a price of about six or seven cents a pound. One can only speculate as to the large future uses of it; it is made from the cheapest materials; the reducing agent is cheap carbon; and you have metallic silicon from the electric furnace.

The zinc industry is attracting a great deal of attention. It is, apparently, one of the least progressive of the metallurgical industries. Little bits of retorts are heated to a high temperature, few shovelfuls of roasted ore mixed with carbon are put into each retort and left there for 24 hours. Everything is done in a very homeopathic way, and yet it is so difficult a metal to handle that it is only by holding fast the ground gained that it has reached its present status. The electric furnace zinc industry has been made successful in Europe; there are works in profitable operation in Norway, Sweden, and Finland, while much skillful experimenting has been done in American. Last year 4000 horse-power was being used in producing zinc

in Scandinavia, and 7000 horse-power has been added since then. The firms are very reticent about their methods; in fact, there is no reliable published data about their present type of furnace.

Iron and Iron Alloys.

The manufacture of ferro-manganese, ferro-tungsten, etc., for making special steels, is done almost entirely in the electric furnace. The oxide of iron is mixed with the oxide of the metal to be reduced, with sufficient carbon for reduction. It takes about half a horsepower year to produce a ton of 50 per cent. ferro-silicon, for instance. The chief seat of this industry is the Savoy, in France, but the industry is gaining ground in the United States and Canada, and imports are decreasing. Stassano, in Turin, was the first to make such alloys, using his arc-radiation furnace, but enormous furnaces (Helfenstein's) of 5000 to 10,000 are now used in this industry, which thus led up to the electric furnace manufacture of pig-iron and pig-steel.

The manufacture of the cheapest metal we have from the cheapest ore we have by electrometallugical processes is, I suppose, one of the greatest triunphs of electrometallurgy. The electric current can really be used for doing what is now done in the blast furnace and it is possible under some circumstances to replace it by an electrometallurgical furnace; that is the last triumph of electrometallurgy.

In one little place in Sweden that I visited two years ago, charcoal was getting scarce and they were importing coke from England to run their blast furnaces, and the quality of the product was not that of iron made with charcoal. They were much interested in the electric furnace, because it requires only one-third as much fuel to make a ton of pig-iron as the blast furnace. In their blast furnaces, with the charcoal available, they could make 300,000 tons of pig-iron, but in the electric furnace they could make 900,000 tons with the same fuel; so that was one of the inducements to use the electric furnace. The Swedes spent a quarter of a million dollars before they had a successful working furnace. They did their work in a most scientific way all through, watched their temperatures and all the conditions, and knew exactly what they were doing all the time. As a net result, they made pig-iron in the electric furnace as cheaply as they can in their blast furnaces. The Jern Kontoret (Iron Masters' Society) bought the patents for the furnaces, so that they became the common property of all the ironmasters of Sweden, and they have been putting up furnaces pretty rapidly. The last one was designed for 12,000 horse-power. It has been running for nearly a years at from 6000 to 8000 horse-power, making 55 tons of pig-iron per day. If it were run at full capacity, I think they could make 100 tons a day, which is equal to the average capacity of one of their blast furnaces.

At Domnarfvet and Hagfors, in Sweden, the same thng is pending. At the later works they calculate that with this large furnace there is a margin of $2.50 per ton on the cost of pig-iron, to the advantage of the electrical furnace over their blast furnaces, so that electric furnace pig-iron is being made at a profit and cheaper than it could be made in the blast furnace in Sweden.

The possibility of making a product from this furnace which is not pig-iron, but which, as far as carbon content is concerned, will have to be classed as steel, has been proved. That product, with less than two per cent. of carbon, is in reality impure steel and not cast iron. It requires only a small amount of refining to bring it to pure steel. With the excess of iron ore present in the furnace you can make a low-carbon product. With electricity to furnish the heat, you can regulate the carbon so as to make a product with only two per cent. of carbon. This is a possibility with an electric furnace, but it is not a possibility with the blast furnace. We can thus make pig-steel, with less than two per cent. carbon, which can be converted in the open-hearth furnace into pure steel in about half the time that the ordinary product of the blast furnace takes. This will bring advantages with which the blast furnace cannot possibly compete. In the case of the problem being worked out, pig-steel will replace pig-iron for the manufacture of steel; this opens up the possibility of the electric reduction of iron ore going into use in places where otherwise it would not go if the product were simply pig-iron. It may come into Canada or along our northern borders where water power can be obtained cheaply, for there is the large expenditure of 3000 horse-power hours per ton of product to be reckoned with. This will be the next great advance in the electrometallurgy of iron and steel.

A new process has been worked out by a German engineer for the recovery of zinc and other metals from slags and complex ores. When zinc is to be slagged off in the blast furnace, it is customary to employ a charge rich in iron. This forms a ferro-silicate which is supposed to combine with the zinc oxide to from a fusible slag. By charging the molten slag in a closed reverberatory or, better into an electric furnace, and adding enough lime to make a rich lime slag, and increasing and continuing the heat, the zinc may be driven off and collected in the form of oxide in suitable flues. Any lead present is carried off with the fume. In case of coal-fired reverberatories being used, agitation of the charge is necessary, but the electric furnace gives sufficient heat to render this unnecessary. Complex ores are first smelted with a high iron and low lime slag, which operation may be performed in a blast furnace, after which the slag is tranferred to reverberatory or electric furnace and there treated with lime and additional heat.

Pipe for handling acid mine water may be lined with either lead or wood. The lead lining is more durable and satisfactory but it is also more expensive. Pipes lined with wood have been in use in the Leonard mine, Butte, for four years without change, and seem to be still in good condition. Porous pine soaked in linseed oil seems to form the most satisfactory wooden lining. It yields under lateral pressure and takes up a good proportion of oil. Trouble with wood lining is due to undue swelling from the absorption of water, and this the soaking in oil is intended to prevent. Unless the ends of the lining strups are trued down carefully so that they do not extend beyond the shoulders of the pipe, the strips in swelling will buckle in the middle destroying the continuity of the lining. When the strips are cut even with the end of the pipe the swelling will be just, sufficient to make a tight joint. In assembling the ends of the lining are treated with tar, and rubber gaskets are used to insure a tight joint.

Ductile tungsten, says The Electrical Review and Western Electrician, is practically insoluble in all the common acids; its melting point is higher than that of any other metal, its tensile strength exceeds that of iron and nickel, it is paramagnetic, it can be drawn to smaller sizes than any other metal (0.0002 in. in diam.), and its specific gravity is 70 per cent higher than that of lead.

Mining in Zacatecas.

At present there are two classes of ore shipped from the district—copper ore and silver ore. The copper ore comes from the Magistral, the Parroquia, and a little from the San Roberto.

At present less silver ore is shipped from the district than copper ore, although probably few people outside of Mexico know that any copper ore is mined at Zacatecas.

There are two classes of this silver ore—the iron-sulphide ore and the straight silicious ore. The iron-sulphide ore comes from the properties along the Mala Noche vein, but there is also said to be considerable of this class of ore in the Quebradillas mine.

The iron-sulphide ore shipped assays 1500 grams silver and 20 grams gold per metric ton, 20 per cent. silica, 30 per cent. iron, and 2 per cent. zinc, with occasionally a little lead. The ore shipped from the San Roberto mine, wich carries the largest excess of iron, averages about 2000 grams silver and 16 grams gold per metric ton, 31 per cent iron, 2 per cent. zinc, 24 per cent. silica, and 38 per cent. sulphur. The ore shipped from the San Bernabe mine assays 1200 grams silver and 15 grams gold per metric ton, 20 per cent. iron, 5 per cent. zinc, 24 per cent. sulphur and 40 to 45 per cent. silica. In these ores native silver and ruby silver are found as well as argentite. Much of the silver, however, occurs in the pyrite. The straight silicious silver ore, such as comes from the Veta Grande and the Cantera vein systems, is highly silicious, often containning as high as 75 per cent. silica. This ore, as shipped, carries, per metric ton, 1500 grams silver, 2 to 10 grams gold, and no lead, the silver occurring mainly as argentite, but also native and as ruby silver.

It is said that in the gold veins at the San Cristobal much of the ore carries, per metric ton, 100 grams silver and 12 grams gold, in a highly silicious gangue.

Mining Conditions.

In the Bote underhand stoping, with undercut drift and raises put up through the orebody, is used, but in the Magistral overhand stoping is used with waste filling. At the Magistral the ore is blasted down until the stope is filled; then it is mucked out and the stope again filled with waste. The diorite walls in the Veta Grande mine are said to stand well as do the walls of the Mala Noche, so that Zacatecas seems to be as fortunate as most of the other camps in Mexico in regard to strong walls.

The mines are not wet, for the Bote, which has been working on a large scale for 60 years and has as extensive workings as any other mine in the camp, makes less than 150 gal. of water per minute, this being handled by a Cornish pump. The Veta Grande mine makes a little more water, but probably no mine in the district makes over 200 gal. per minute.

The Bote, Magistral, San Roberto, the Mala Noche and some other of the properties are equipped with good steam hoists.

While formerly many "patios" were running in the district, very few are now intact, and although several mills have been erected, the Bote pan-amalgamation mill is the only one that ever ran for any length of time.

Cost of Mining and Supplies.

At Zacatecas there is an abundant supply of labor, so that it is low-priced but dear. The cost of driving varies considerably in the district, for the rock varies greatly in hardness throughout the camp. At the Magistral a 5×7-ft. drift is driven on contract for 16 pesos per meter, the mine furnishing everything and delivering the rock at the shaft. At the San Roberto a 6×6½-ft. crosscut in ore is driven, when the ore is soft, for as low as 12 pesos, but in harder ore from 20 to 35 pesos is paid.

At the Bote where the vein is wide the drilling and blasting (powder cost not included) averages about 50 centavos per ton. At the San Roberto, where mucking is done on contract, the ore is shoveled and delivered at the shaft for 20 centavos per ton.

For sorting the ore the price varies at the different mines. At the Bote for sorting the silicious silver ore 1.50 pesos per ton of accepted ore is paid; at the San Roberto mine for sorting the iron-sulphide-silver ore 2.25 pesos is paid per ton of accepted ore; at the Magistral 1.25 pesos is paid to the rough sorters per ton accepted, for sorting the chalcopyrite ore, all the ore being re-picked by company sorters before being accepted.

Conclusions.

The geology of Zacatecas is very similar to that of Guanajuato, for the same rocks, apparently of the same age, occur at both places. The ores are similar except that at Guanajuato no copper ore is found, and little silver ore carrying a large amount of pyrite, such as occurs in the Mala Noche vein. But at Guanajuato the Mexicans mined to considerable depth, while at Zacatecas their work has not been deep. This fact, together with the occurrence of a barren zone at a depth of about 150 to 170 m., has caused the impression that the ore does not "go down." The fact is that little deep mining has been done at Zacatecas, and therefore, practically nothing is known about the camp in depth. The camp needs development, for up to the present most of the mining at Zacatecas has been gophering. There is much virgin ground in the district and the developments at the San Roberto show the possibilities of good common-sense mining.

The camp will need, after the mines warrant their erection, cyanide mills for the silicious silver ore and concentrating mills for the ore from the Mala Noche vein in order to prosper. The mines furnish enough water for cyanidation provided the water is properly conserved, but for concentration water will have to be brought into the district or the ore hauled to the water; probably the latter is the more feasible.

The silicious ore can be cyanided as successfully as the Guanajuato ore and the iron-sulphide silver ore can be easily concentrated. It is not a question of metallurgical treatment upon which the future of Zacatecas depends, but upon the developments at depth in the mines, and it hardly seems possible that veins as large as those at Zacatecas and which have produced so large a tonnage, will not furnish milling ore at depth. Zacatecas, with its own special problem, lies waiting as did Guanajuato only a few years ago.

The total amount of copper produced in the United States since 1845 is 18,857,476,910 pounds, according to the United States Geological Survey, the largest production in any one year being 1,243,268,720 pounds in 1912. The production in 1845 was 224,000 pounds.

Iron Copper Deposits of Chile.[*]

It is evident that many of the iron deposits of Chile were at one time under the sea and were afterward raised into what now is known as the Cordilleras and with the decomposition of these first deposits there have been formed beds, pockets, stockworks. and surface deposits which can be seen on the declivities and summits of the mountains. In the Department of Chañaral at an altitude of over 600 metres above sea-level, there are to be found maritime deposits of recent geologic age. The iron deposits here, as a result of the violent upheaval, are seen in various forms. In some places they appear as true stratified deposits dipping into the mountains, and in others as massive deposits lying on the barren granite or porphyry. The depth to which these deposits extend can only be determined by drilling. The large superficial showings of oxidized ore which are accompanied by smaller ones intimately associated with them, are evidences of the existence of bedded and blanket deposits at depth. In some localities bedded and vein deposits of great length and richness are to be seen. This class of deposits is found to consist of a pure oxide of iron to great depths. There is always the probability that these oxides of iron are a cap which covers deposits of copper minerals.

Copper-Iron Minerals.

Copper minerals in association with iron manifest themselves in various forms. Sometimes at a few metres from the surface, the iron mineral will carry two, three, or even a greater percentage of copper (as is the case at Pueblo Hundido, Carmen, and other localities), and such an ore carrying considerable copper will extend to great depths. At other places are found fissures and small veins of high-grade copper in the main body of the iron oxide or in that zone lying between the vein or bed proper and the wall rock, but without extending into the deposits proper. One can be certain of not finding copper mineral in the iron ore in these occurrences Copper is also found as phosphate and sulphate in certain zones of a deposit, but will disappear as length or depth is attained. These variations in the quantity and quality of the iron minerals in the various deposits make it necessary to prospect the property thoroughly before it is possible to make an absolute statement as to their value as deposits of commercial importance. In special reports on the geology of the country in which these deposits are found, it is possible to find some information as to their prospective importance and the best means of exploiting them.

Geographical Position.

A study. which is as yet not completed, of the iron deposits of Chile, makes it possible to a certain degree to establish a general rule correlating the importance of these deposits from a commercial, industrial, and metallurgical standpoint with their situation in different parts of the Republic. Up to the present time there has not been found any deposits of high-grade iron ore in the southern provinces of Chile. Only low-grade limonite has been found in that region. The deposits of importance begin to appear at Parral in the province of Linares and extend north from this point. In the provinces of the central part of the Republic, are deposits of a good grade of iron ore, but these are generally not very extensive, and their position is so far distant from the coast that for the present at least, they cannot be exploited at a profit for the export trade. The deposits of greatest importance are situated in the provinces of Coquimbo, Atacama, and in the southern part of the province of Antofagasta. From this southern zone of the province of Antofagasta to the north, little is known at the present time. However, there are known to exist some deposits (as at Mejillones) of iron ore, which always contain copper or other metals.

The most important result of the latest studies has been to permit correlations of great precision between these deposits and to arrive at conclusions as to their general trend. The general course of the deposits is north and south, and these lie at somewhat fixed distances from the coast. Three systems of veins have been recognized to date. Naturally, the respective distances of the orebodies from the coast vary with the irregularities of the coast line and the conditions under which the particular part of the mountains containing the deposits was elevated. In a general way it may be stated that the first system of veins, which are found beginning at the sea shore on the west coast, extend to the east a distance of from 10 to 12 kilometres. The deposits at Tofo, Juan Soldado, Romeral, Huachalalume, Cifunchos, Cachina, Potrero (Taltal,) Mejillones (Cobrizos), and others may be mentioned as belonging to this system. The second system is from 20 to 30 kilometres to the east and embraces the following deposits: Infiernillos, Dorado, Tunillas, Cristales, Algarrobo, Yeso, Depositos de Bodegas y Chamonate (department of Copiapó), Varillas, Sierra Aspera, and others. The third zone is from 100 to 150 kilometres to the east and includes the following deposits; those of the provincia de Santiago, Yacimientos de Illapel y Combarbalá, San Marco (departamento de Elqui), Potrero Seco (departamento de Copiapó), Púquios, and others.

Domuño Deposits.

Before speaking of the important deposits in general, I will give a brief description of the deposits at Domuño, which is near the port of Quintero in the department of Valparaiso and which was recently studied. On the side of the mountains at an elevation of 400 metres above sea-level and eight kilometres from the coast, in the argillaceous schists there appear some veins from 0.4 to 0.2 metres in width of specular and micaceous oxide of iron. On this vein there was sunk a small shaft to a depth of two metres and lower down an adit was driven into the deposits a distance of 12 metres. It was found that with a little depth the iron disappeared and in its place were found high-grade copper ores.

In the province of Coquimbo and the department of Serena may be mentioned the following mines which are of importance: the Tofo, Cristales, Juan Soldado, and Romeral. Recent developments at the Tofo property have confirmed the views set forth at the convention at Leeds, namely, that the deposit would become of increased importance as depth is attained. An adit which has opened the deposit at

[*] Abstract of official Bulletins.

a depth of 180 metres has revealed a large deposit of ore of the same nature as that at the surface. The ore which is at present in sight in this deposits may be safely estimated at 150,000,000 tons. Recently he Bethlehem Steel Company of North America has made a contract with the Sociedad Altos Hornos to buy ore from this property for a term of 15 years with the privilege of extending this time, at the rate of over one million tons of ore per year. This production will in no way interfere with the supply necessary for the Corral company. The work will be conducted under American supervision. The Bethlehem company is going to spend $8,000,000 in preparation for this work. The plans include the construction of vessels for the special purpose of transporting the ore from Chile to the United States.

The mines of the Cristales district have not been developed to sufficient extent to date to ascertain the exact extent of the orebodies, but there is reason to believe that these orebodies will lead to deposits of importance. It is believed that it will be a comparatively easy matter to transport the minerals of this district to the coast, as a railroad is to be constructed which will supply an outlet. It is also proposed that government engineers will explore this country by means of drills. Various samples, which have been taken, show 60 per cent. Fe and some have a high copper content, but the copper is usually independent of the amount of the iron.

Mines of the Juan Soldado District.

In former discussions of this district I have presented the information which has been obtained from engineers who have made a special study of the region and have thoroughly prospected it. Some of the prospects, particularly those which have been discovered in the Chacay district and farther south in the Jardin (Quebrada Honda) country, have been proved to be superficial. Trenches, which were cut, went to the barren rock. On the slopes of the mountains in the southern part are to be seen some outcrops from two to three metres wide, which are of interest. A vein one metre wide is also known in the Portezuelo district, but has not been prospected. Many veins are to be seen in a ravine which traverses the district in a north and south direction. The principal vein-system is cut at rigth angles by another system. Little, however, is known of these deposits. To the south of Romeral, passing down the valley to the Triga district, there are veins which do not outcrop, but which are covered with earthy material. Some of these veins are from 10 to 12 metres wid eand appear to constitute good deposits. Between Romeral and Juan Soldado, is the Cepo valley, and the Rincon de las Minas, with numerous outcrops of veins from two to three metres wide and containing a good grade of iron ore with no copper. While the mineral deposits of this region are numerous it would be difficult to work them at a profit. The principal difficulty would be in the mining, which through the nature of the deposits would make exploitation expensive.

The Romeral deposits are situated three kilometers to the south of Juan Soldado and 15 kilometres to the east of Punta Teatinos. The superficial deposit of oxidized ore has a general width of 250 metres and a length of about a kilometre. The deposit may be considerable as being divided into two parts. In the prospecting work which has been done in the district some good deposits of oxidized ore have been found. It would be well to prospect the ground with drills in order to determine more regarding the extent of these deposits, which are most attractive from the standpoint of quantity and quality of the ore and the ease and economy with which the deposits may be exploited. With the work which has been done to date it may be said that there is at present in sight 15,000,000 tons of good iron ore. The nearest port would be Punta Teatinos; this, however, is an exceedingly poor one and a large amount of work would be necessary to protect it from the south winds. At the present time the only port available is Coquimbo.

Mines of the Department of Ovalle.

As one leaves Ovalle in the direction of Punitaqui, at a distance from the city of 15 kilometres, after passing a narrow pass called Cruz Colorada, the sides and tops of the mountains of the west of the wagon road, particularly at a point called Piedra Rodada, show interesting deposits of iron oxides which have a southeast and northwest trend. A railroad has been proposed which will connect Punitaqui with Ovalle and which will pass at the foot of these hills. I have seen large masses of good oxide of iron and also large quantities of mineral, which was not in place, in the district. On the other side of the mountains are to be found the copper mines. To the north are found deposits of iron ore carrying some copper. One of these copper deposits has been prospected to a depth of 15 metres. The principal iron outcrops are to the south of the district.

A shaft was sunk to a depth of 60 metres on the Dorado property and is reported as being in a pure oxide of iron. Mr. Echegarai has made an examination of this deposit and has found some indications of copper and a four-metre vein of good iron ore. With these proofs of a deposit whose apex is high above the plain and which is known to continue in depth, it can be stated that there are many millions of tons of iron ore in it. At the foot of the hill and four kilometres to the south a prospect shaft was sunk four metres and is in good iron oxide. It is planned to continue this shaft to a greater depth. The freight rate from Dorado to Tongoi is about $1.80 per ton, but this figure could undoubtedly be reduced to less than $1.50.

At a distance of 33 kilometres from the city of Coquimbo, near Islon, in what is known as a copper country, are to be found good indications of iron. In many deposits the copper is found intermixed with iron and the ore is very silicious. It would be interesting to investigate these deposits at depth. In the same province at a short distance from the railway, which runs from Serena to Vicuña, in that locality in which ferro-manganese mines were formerly worked by Joaquin Naranjo , it would be interesting to make a further investigation of the manganese iron deposits.

Department of Atacama.

At Yeso, in the department of Atacama, pockets of a black oxide of iron, which do not outcrop at the surface, have been found. These deposits are also to be found in the neighboring hills, but there has not been enough exploration to determine their importance. At Huanteme there are two deposits of iron oxide. The largest has a width of 60 metres and a length of 100; the smaller is 80 metres long and 15 wide. It is probable that these deposits are superficial. The deposits are composed of a dull gray hematite with some magnetite. The Mantos group gives promise of some importance. The last claim, the Beatriz, is 200 metres from the Coquimbana and is 12 kilometres from the mine of that name. This

vein has the characteristics of the Coquimbana vein and might be a branch of it. The minerals of this deposit should carry manganese. The vein is two or more kilometres long and five metres wide. The ore is a gray hematite. The Chañar Quemado mines are the most interesting of the department. The principal orebody is 100 metres long and 40 metres wide. The ore is a magnetite. There is a surface deposit of about 40,000 tons of a good oxide of iron. Not enough work has been done on any of these groups to permit an opinion as to their future possibilities. The Santa Lucia deposits lie to the north and show some evidence of mineralization. The principal deposit is 80 meters long and 20 metres wide. The formation is irregular and there is no ore on the surface. The Los Colorados deposits appear to be the most extensive of the entire region.

Speaking of the deposits in general, I do not think they are, for the present, of economic importance because of the grade of the ore and the high cost of transportation. To work the properties, expensive railroad construction and aerial tramways would be necessary. As exceptions, however, might be mentioned the Mantos, Chañar Quemado, and Los Colorados deposits, concerning which it is impossible to give an exact opinion through ignorance as to the quantity and quality of the ore at depth.

Department of Copiapo.

In the department of Copiapó iron deposits are in evidence in many localities. The Potrero Seco deposits are 123 kilometres from the port of Caldera. The deposits are irregular and occur at an altitude of about 720 metres above sea-level. The ore appears as outcrops of magnetic oxidie of iron, specular hematite, and pyrite. The owners of these properties plan to make a thorough investigation of the deposits. As it is, nothing definite may be said as to their importance.

In the Copiapó district, four kilometres from a little station named Carpa IV, there is a deposit known as the Chamonate. This deposit outcrops with a width of 2½ metres in the form of a dike which has a general north and south trend. Farther to the north there are other outcrops of iron oxide 3½ metres wide, some of which contain manganese.

Seventy-five kilometres from the port of Caldera and 4½ kilometres southeast of Bodegas there is situated a group of iron deposits known as the Bodegas deposits. The outcrops have been very much decomposed and the mineral occurs as a pure magnetite. In the neighborhood there are copper deposits which have been formed in a carbonate of lime formation. The first of the iron deposits is 60 metres long and 25 wide; the second, which is to the south, is 100 by 50 metres, and a third deposit is of the same size, but broken in formation. These deposits are 280 metres above the valley and it would be possible to transport the ore from the mine by means of an aerial tramway. Other deposits than those mentioned are known in the district. It would be very commendable if the government would undertake drilling operations in one of these localities, such as the Chamonate, in order to ascertain something as to the nature of the deposits at depth and also to learn if water is to be had by sinking.

Chañaral Deposits.

The Granate deposits are in the Sierra del Buitre in the Tierra Amarilla district about four and a half kilometres from the railway. One of the veins here is three metres in width and can be traced for a distance of 400 metres. In some parts of the vein there are copper-bearing minerals. In the Sierra de Gallegüillos, at a distance of 30 kilometres from Copiapó and at a distance of about 30 kilometres from the bay of Obispito are situated the Portezuelo Negro deposits. Here are known to exist a number of veins of about four metres in width. It would be interesting to prospect this district at depth and ascertain if the many veins united at depth to from one large orebody. The iron occurs as oxide.

The deposits in the department of Chañaral at Varilla are large and important. These orebodies, which have been known for a comparatively short time, are situated at a distance of nine kilometres from Vetado, on the railway from Chañaral to Pueblo Hundido. The station is 13 kilometres from the port of Chañaral. The general strike of the veins of the district is north and south. The outcrop is well pronounced and forms a dike of iron oxide which is about two and a half kilometres long. The width of the dike and its branches vary from 10 to 60 metres. The ore which is on the surface amounts to over 500,000 tons. It would be an easy matter to construct an aerial tramway from these deposits to the station at Vetado, a distance of about nine kilometres, from which the ore could be transported to tidewatre at Chañaral. It is possible to transport the ore the entire distance to the port by means of an aerial tramway, which would be about 22 kilometres in length. I have been told by a reputable French hydraulic engineer that it would be easy and cheap to construct a breakwater at the railroad terminal as a protection against the south winds and a pier where it would be possible for large boats to dock. At a distance of 12 kilometres to the west of Pueblo Hundido and at a short distance from the railway, concessions have been asked for the exploitation of iron deposits of an exceedingly good quality.

In the department of Taltal in the province of Antofagasta there are numerous deposits of iron ore. The Cifunchos deposits are situated at a distance of about 12 kilometres from the bay of Cifunchos and at a height of 100 metres above sea-level. Five distinct veins are to be seen here about 2 metres wide, which extend in a north and south direction for a distance of 2000 metres. Samples which have been taken, indicate a good oxide of iron. To the north of these deposits there is a deposit known as El Vetado, which has a width of from 1½ to 2 metres. Both timber and water are to be had for mines in this district.

The Cachina deposit is situated at a distance of about 7 kilometres to the east of the port of Taltal in a claim known as Miramar at an altitude of 600 metres. The general direction of the strike is northwest and southeast. In an open cut on the claim known as the Salvadora, the vein is about three metres wide. It is not known as yet what the size of this deposit will develop into. The ore is a good grade of red hematite. To the north of this deposit are the Esplotadora, Miramar, and Valparaiso, and to the south the California and Mexico deposits, which have a length of three kilometres. Throughout this entire length, but with interruptions, are to be seen beautiful outcrops of iron oxide. The deposits could be worked by open-cut methods.

The Potrero deposits are of great interest. The Vencedora, Chile, and La Norte Magnética may be of importance. In an open cut in the Alemania claim good iron ore has been exposed. Four metres

of good oxide has been opened in the Vencedora claim. There are many faults through the district and the veins which are exposed at the surface may be the branches of a large formation which would be found in depth. Between the larger veins are numerous smaller deposits varying in width from a half to two metres. Sometimes these veins contain copper minerals. The Palermo vein is three metres in width. The strike of the vein is east and west with a dip to the south. Preparations are being made for the prospecting of deposits which are known to exist in the desert to the north and at a little distance from the coast.

There is still much to be learned concerning the iron deposits of Chile, not so much in the south as in the north, but before becoming too much occupied with the deposits that remain to be discovered it would be more profitable to devote more attention to the known deposits and learn something further as to their real value.

*Newer Theories of Ore Deposition.**

By Prof. J. F. Kemp.

When the International Geological Congress assembled in Berlin in 1885 it was raining furiously. The minister of the interior welcomed the delegates with these words: "To members of your calling, in which water plays so large a part, I need make no apologies for the weather." It is the universal experience that we cannot discuss the deposition of ores without calling upon water as the chief agent in the process. We learn that Agricola believed the veins to be formed by what he called the juice of the earth. He did not specify its particular source, but his views were evidently not very far form those held by many today. One of our own phrases is, the juice of the magma.

Whenever we discuss the formation of veins, the idea of solutions of some sort is necessary. In the early fifties the distinguished French geologist Elie de Beaumont prepared a paper upon the connection between ore deposits and volcanic phenomena. He concluded that emissions from igneous rocks were not without their decided importance, but his views attracted little attention and were largely overlooked in the discussion of the next 50 years. The general attitude of those who thought about the subject was somewhat as follows, which we may formulate even though we would find it difficult to point to their exact expression in any particular work. Rains were observed to fall upon the surface of the earth. The rain water was believed to percolate downward through cavities in the rocks, and to furnish the ground water. In certain wet mines the amount of ground water was highly impressive. Observers therefore concluded that it continued in its downward passage through the rocks to relatively great depths. During its descending it wandered extensively and took into solution the minerals of our ores and gangue from the rocks with which is came in contact. Encountering, perhaps, a large waterway, such as might be furnished by a fault line leading to the surface, the solutions mounted upward. Coming from regions of heat and pressure, they passed gradually to those of lower temperatures and diminishing pressures; the dissolved minerals were precipitated, the veins were filled, and hot springs emerged at the surface.

These views were to some extent committed to paper; they were also expounded in the lecture room by Le Conte in the University of California and Newberry in New York. They also found more or less definite expression in the writings of S. F. Emmons and others not engaged in teaching. Whether or not masses of intrusive rock as storehouses of heat assisted in stimulating circulations is not always definitely stated, but probably they were regarded with respect by some, although Dr. Newberry was always rather strenuously opposed to their influence in the production of ores.

Posepny on Ore Genesis.

We come now to the meeting of the American Institute of Mining Engineers, which was held in Chicago in connection with the World's Fair in 1893. Every endeavor had been made to present a program of unusual importance. The great paper of the meeting was that from Franz Posepny upon "The Genesis of Ore Deposits." The essay was one of exceptional value, and embraced the results of observation and reflection extending over a life-time. Posepny established two zones. The upper one, between the surface of the earth and the standing ground water, he called the vadose, or shallow zone. In it the operation of the descending rain waters were of an oxidizing nature, and were extremely vigorous. From the level of the ground water to an indefinite depth extended the deep water zone. The movements of the deep waters were slow. The extent to which they penetrated into the earth is not definitely stated, but great attention was given to uprising springs in mines.

There is little doubt that the deep waters were regarded by Posepny as originating in the rainfall. The fact that no definite statements were made regarding the depth to which they continued left an important opening for further contributions. Posepny's paper, as we all know, led to an animated discussion, practically all of which ran in favor of the views which he had advanced.

In 1900 interest in the subject was again aroused by the presentation to the American Institute of Mining Engineers of another paper by Prof. C. R. Van Hise, entitled "Some Principles Goverming the Deposition of Ores." The subject of cavities in rocks received careful attention. The depth to which cavities can maintain themselves beneath the ever accumulating load of superincumbent rock had been calculated by a colleague, Prof. Hoskins. It was placed at somewhere about 10,000 meters . Water, practically all from the rainfall, was believed to extend down to the limit of cavities; to pass through extended masses of rock, wandering more or less laterally; and after taking into solution the minerals of ores and gangue, and after absorbing much heat because of the normal increase of temperature with depth, to rise again to the upper world, depositing the vein filling in its passage.

Three zones were established: a zone or belt of weathering or solution, corresponding to the vadose zone of Posepny; a zone of enrichment on or near the water level and a zone of cementation or precipitation at great depth. These views were verified by many examples and were presented in a way that carried

* From an address delivered before the American Institute of Mining and Metallurgy.

almost universal conviction. We may say that they marked the high tide of the views dependent upon rain waters, often called the meteoric waters, as agents in the production of veins. From them we may now turn to the development of others of a contrasted nature, and then to certain limitations to which the views dependent upon the rain waters are subject.

Vogt's Magmatic Doctrine.

Early in the nineties readers of the literature on this subject began to be impressed with the valuable contributions from Prof. J. H. L. Vogt of Christiania, Norway. In the first volume of the Zeitschrift fur Praktische Geologie, Prof. Vogt published a series of papers embracing views which he had gradually deveoped after years of study in Norway. They relate partly to the basic masses which we find in igneous rocks, such as the titaniferous iron ores, which are direct crystallizations from a molten magma; partly to the border effects of igneous masses, effects which were believed to be due to emission from the igneous rock. In the latter group come the pegmatites with their contents of rare earths; the tin ores associated with quartz, feldspar and mica; and apatite deposits in close connection with intrusive masses of gabbro. These deposits Prof. Vogt called "pneumatolitic" when produced by vapors in connection with liquid water.

The first papers of Prof. Vogt have been followed by a long series since then. The ideas suggested were also germinating in the minds of others on this side of the water. We find in the monographs of J. E. Spurr, on Aspen and on Mercur, the conclusions that the ores were derived from some deep-seated mass of igneous rock. During these years in the decade of the nineties, we all began to think there must be something in the waters which might be derived from crystallizing bodies of molten and cooling masses. Some of us were also wondering whether the meteoric waters quite met all the requirements of the case.

At the meeting of the American Institute of Mining Engineers, held in Richmond in 1901, I made the point that the deep mines, which were rapidly multiplying in various places the world over, passed through a zone of water-bearing rocks, and if the water were impounded in the upper levels, their lower workings were practically or actually dry. There were indeed one or two regions of expiring igneous activity, such as the Comstock lode, in which bodies of water were met at great depth. But we may set these aside because the waters are open to the charge of being magmatic. The universal experience elsewhere proved waters to be limited to the upper 1,000 or 2,000 feet of the crust.

Of course, if our experience gained in mines is a fair indication of the distribution of meteoric waters in the earth, then the old views become untenable. We might infer that a suddenly developed fault would tap them downward along its course but if we try to imagine our veins to be filled by waters which passed downward in the restricted area of a fault, become to a limited degree influenced by interior heat, and rose again to the surface with very limited lateral wanderings, we are confronted with great difficulties in accounting for the filling of our veins. The metals are very sparsely distributed in the rock. Waters could gather up the amount which we find in our veins only by extensive wanderings; the limited circulation in and around a fault would be insufficient. The same view of the distribution of ground waters was shortly after adopted by T. A. Rickard and John W. Finch, in important contributions.

Magmatic Waters.

From another source the idea of magmatic waters received strong support in 1902. At the famous health resort of Carlsbad, Bohemia, was held a congres of physicians and scientific men. At the invitation of the congress, an address was delivered by the venerable Austrian geologist. Edouard Suess, on the Carlsbad hot springs. Prof. Suess, as a very young man, had made one of his first contributions to science, many years before, in a paper on these springs and had considered them during all the years of his subsequent life. He made the point that they were in no respect sympathetic with the rainfall; they poured out the same amount in times of flood and of drought, as testified by the records of a thousand years.

The spring waters are strongly charged with lime, and yet they come to the surface through granite, a rock extremely low in lime. He therefore insisted that they could not conceivably originate in the rainfall, but that they were deep-seated waters, probably coming from some such mass of igneous rock as a basalt. Since they there reached the upper world for the first time and were young, so to speak, he called them "juvenile" waters. Since then, the name "juvenile" has been used as a synonym of "magmatic," although from the different sense in which "juvenile" is used in English, the term "magmatic" is generally preferred in this country.

Another support for belief in magmatic waters is found in the phenomena of volcanoes. For many years geologists have observed that clouds of steam, or at least, of a vapor believed to be steam, were pouring forth from active vents. The conclusion was generally reached that the expanding and even explosive steam had much to do with the bringing of lava to the surface. Geologists had also observed that volcanoes were chiefly situated near the sea coast, or upon marine islands. A view was often expressed that the sea water, percolating through the rocks, migrated toward and into the hot molten magmas and thus furnished the steam which finally emerged from the vent. An experiment of Daubree was cited in support, which showed that water could be drawn by capillary attraction through an inch or two of porous sandstone into an underlying and tightly enclosed chamber in which was a pressure of one or two atmospheres.

Reflection brought out the important point, however, that it was a very different thing for water to emerge into an open cavity at moderate temperature and comparative low pressure, and for the same water to migrate through a great thickness of rock of which the temperature gradually increased up to 2,000 or 3,000 degrees F. The course of the water would be away from the highly heated mass of igneous rock as soon as it came within the influence of its heat. We have therefore concluded, in the last 10 years, that the steam rising from colcanoes is derived from gases of deep-seated origin, dissolved in the molten rock itself and brought by it to the upper world.

Volcanic Waters Questioned.

About 1910 a Swiss chemist named Paul Brun, residing in Geneva, published some views antagonizing the existence of water in volcanic rock. Mr. Brun had begun by determining in a careful way the fusion temperatures of feldspars and other rockmaking minerals. In this way his name first became known to geologists at a distance. He then devoted himself to visiting volcanoes, takin samples of their emitted gases and analyzing them, especially for the determination of water. As the result of his analyses, he came to the conclusion that neither steam nor water was emitted by them. He believed that the cloud which we so often see hanging over a volcano was finely di-

vided ammonium chloride, and in a paper delivered before the Congress of Mining, Metallurgy and Geology, at Dusseldorf, in June, 1910, he contested the idea of water in volcanoes at all. Subsequently, in a large monograph on volcanic emissions he finally stated that water could no longer be regarded as a factor in volcanic action. These views created great surprise, and while they staggered those of us who had pinned our faith to the presence of water in volcanic rock, they did not convince us. The old-time views seemed so thoroughly grounded that we awaited confirmation of Mr. Brun's results.

In 1912, Dr. A. P. Day and his associate Dr. E. S. Shepherd, of the Carnegie Geophysical Laboratory, in Washington, spent some months at the lake of fire in the crater Kilauea of the Hawaiian Islands. Mr. Brun had also visited this volcano and had based some of his most sweeping statements upon the results of his experiments there. By a lucky coincidence, during the stay of Messrs. Day and Shepherd a dome of solidified lava developed on the solid flat a short distance from the great pool of molten rock. It was possible to approach this dome within which the molten lava was boiling and emitting gases. A short iron tube was pushed through a crevice and was connected with a series of hardglass tubes, terminating in 20 condensing glass reservoirs, each holding about half a liter. At the far end was a pump by which the gases were at once pumped through these series of pipes and condensers so as to furnish samples for analysis. The pumping was continued for some time in order to drive out the air already in the tubes, but scarcely had the pump been set in operation before water began to condense in the tubes and the reservoir. In the end, as much as 100 c. c. were condensed in a tube having a total volume of 500 c. c.

When the Geological Society of America met in New Haven during the Christmas holidays of 1912, Dr. Day addressed the geologists present. He told of his trip to the Hawaiian Island and reviewed very carefully, and at length, the experiments and conclusions of Mr. Brun. The audience could not tell, during all his preliminary remarks, what results he had to announce. When, however, he had worked us up to a suitable climax, and produced from behind the desk one of his tubes with 100 c. c. of volcanic water in it, visible to us all, I know that, for one, a great load was lifted from my mind. Since these experiments we have had no doubt about the existence of copious amounts of magmatic waters, and we can not but believe that the deep-seated magmas are often richly provided with them. They are doubtless more abundant in the magmas high in silica but they do not fail in the basic ones. If such a mass of molten rock well provided with gases and fairly deep below the surface is forced into the midst of other rocks; and if it slowly cools and crystallizes to anhydrous silicates, the contained water must be evicted. We have thought that the gases and associated water pass upward and outward, perhaps through an already cooled and cracked shell of the igneous rock, and that then they play an important part in the circulation of the ground-waters.

Corroborative Evidence.

From another significant quarter the evidence has been accumulating. All mining engineers of extended experience in the field know how often deposits are found at the contact of igneous rocks with rocks of a sedimentary nature, and especially with limestones. In the Southwest and Mexico contact deposits are innumerable. The old-time view regarding their formation was that the contact zones were produced from impure beds in the limestone, by the influence of igneous rock. If, for instance, in addition to the carbonates of lime and magnesia, a bed contained silica, alumina, and some iron oxide ,the silica, under the influence of heat, would combine with alumina and with lime or magnesia and such iron as was present, to produce lime silicates and lime-alumina silicates. We came to use a definite name for this group of minerals and called them "the lime silicates." The principal ones were garnet, diopside, epidote, vesuvianite, woolastonite, and a few rarer ones. The garnet was believed to be the variety grossularite, a lime-alumina garnet. Now alumina is a common ingredient of limestones, and especially of the hydraulic varieties, or cement rocks. No great improbability was involved in believing that the grossularite represented a crystallized, aluminous, siliceous limestone, because we know of many such occurences away from the contact zones.

In 1905, however, Professor Lindgren, working upon the zones at Morenci, Ariz., and I, describing others at San Jose, in Tamaulipas, Mexico, simultaneously announced that the greater part of the garnets were lime-iron garnets, of the variety andradite. Now it is one thing to derive a lime-iron silicate from an ordinary lime-stone, and another thing to derive a lime-alumina silicate. Limestone contain very little iron, but the contact zones contain a great deal. They habitually display, besides the silicates, large bodies of magnetite and sometimes of specular hematite. We thus still found great difficulty in believing that such rich iron-bearing zones could be produced by the recrystallization of limestone. We both, therefore, urged that emissions from the igneous rock in the form of steam or its dissociated gases, and of silica, probably in the form of orthosilicic acid, and of iron salts, probably iron chlorides, had been fed into the limestones and had produced the zones. These views were quite learn by reading the earlier literature. No one has ever been able satisfactorily to explain the iron-bearing minerals in any other way. The evidence of the zones is therefore a strong argument in favor of magmatic emissions.

There is still another far-reaching argument in favor of this form of water. If, in accord with the older conception, we imagine the rain water sinking into the rocks and going only to moderate depths, as we are obliged to do, in conformity with our underground observations; and if we imagine it again rising to the surface this comparatively short journey during which we require it to dissolve the irregular and sparsely distributed metalliferous components of the rocks and again to precipitate them in our views in its upward journey, we require it to perform two contradictory reactions under the same physical conditions.

We can hardly believe that under one set of conditions solution would take place, and in another without essential contrasts, precipitation would result. But, on the contrary, if we imagine highly heated and even vaporized emissions to come from the interior of a great igneous mass and to be charged with our ores and gangue, we see that they must very soon be subjected to a marked change in conditions and we may reasonably infer precipitation.

The recent studies of Edwin T. Hodge, which have been based upon the mine waters of sulphide bodies, show that when the rain water starts to percolate downward it becomes, in the gossan, an acid solution of iron, zinc, and copper. As it passes lower through the rocks, especially in the wall rocks of a mine already open, so as to make circulation possible, it gradually becomes neutral; the copper and zinc are quickly precipitated, but iron remains to a somewhat greater but still only to comparatively shallow depths. Before long, the iron also is precipitated and the water becomes

alkalies and alkaline earths. A strong argument is alkaline, with no metals at all in solution, other than therefore made against the efficiency of descending rain waters and against their abilitly to produce the veins with which we are familiar.

Synclinal Basins.

Somewhat of a compromise view has lately been strongly advocated by Professor Lawson, of the University of California. Professor Lawson is well aware of the almost universal association of ore deposits in the Western country with igneous rocks. He believes that the igneous rocks have often entered a synclinal basin as laccoliths, and have extensively cracked the overlying strata, but have remained in the depths, with the strata on both sides dipping from heights of land downward and forward toward them. After the laccolithic mass has cooled enough to permit the circulation of meteoric ground-waters through it, he believes that the waters pass downward by an artesian flow through porous beds at the sides, into and through the igneous rock, dissolve from it the metals and the gangue, and are driven out through cracks in the overlying sediments by the shorter route to the surface.

He cites several cases in which veins are associated with intrusive masses, where he believes the structure to have been synclinal. There is nothing impossible in this view, and it offers a reasonable method by which meteoric waters might accomplish the work. The chief objection is that the intrusive entrance of a mass of igneous rock under ordinary conditions of synclinal structure would tend to elevate the rock above it to a greater altitude than the strata on either side. The flow, we might infer, would be vertically downward into the igneous mass, and outward and upward around its borders, if any flow were to develop; whereas the cracks in which veins might be deposited would seem more likely to be over the laccolite than outside its influence.

In conclusion, we may perhaps carry in our minds the significance of the various arguments advanced, and understand why it is that so many students of ore deposits have come to place their faith in the efficiency of magmatic waters. While the obscurity of the subject is confessedly great, yet, on the whole, deposition by this means has seemed to involve fewer difficulties than if we assume the comparatively feeble agency of meteoric ground-waters. Nevertheless we are all aware that there are certain mining districts in this country, such as those containing the lead deposits of southeast Missouri, the gash veins with lead and zinc in the upper Mississippi Valley, and the zinc deposits of southwestern Missouri, near which no bodies of igneous rock are to be found. Aside from these cases, however, the general experience in the West is that somewhere near an ore body is usually a dike or some other intrusive mass to which we find ourselves inclined to atribute a strong influence in producing the ore.

Oaxaca.

It is generally admitted by mining men who are informed on Mexican mining possibilities that the two States directly to the southwest of Mexico City, namely, Oxaca and Guerrero, are as rich in mineral resources, as any other section of the Mexican Republic. The State of Guerrero, however, is a country truly 'set up on edge,' with its box-canyons and extremely rugged mountains, so that transportation difficulties detract much from its position as a mining region, though it is probably rich in minerals beyond the conception of those who are best informed.

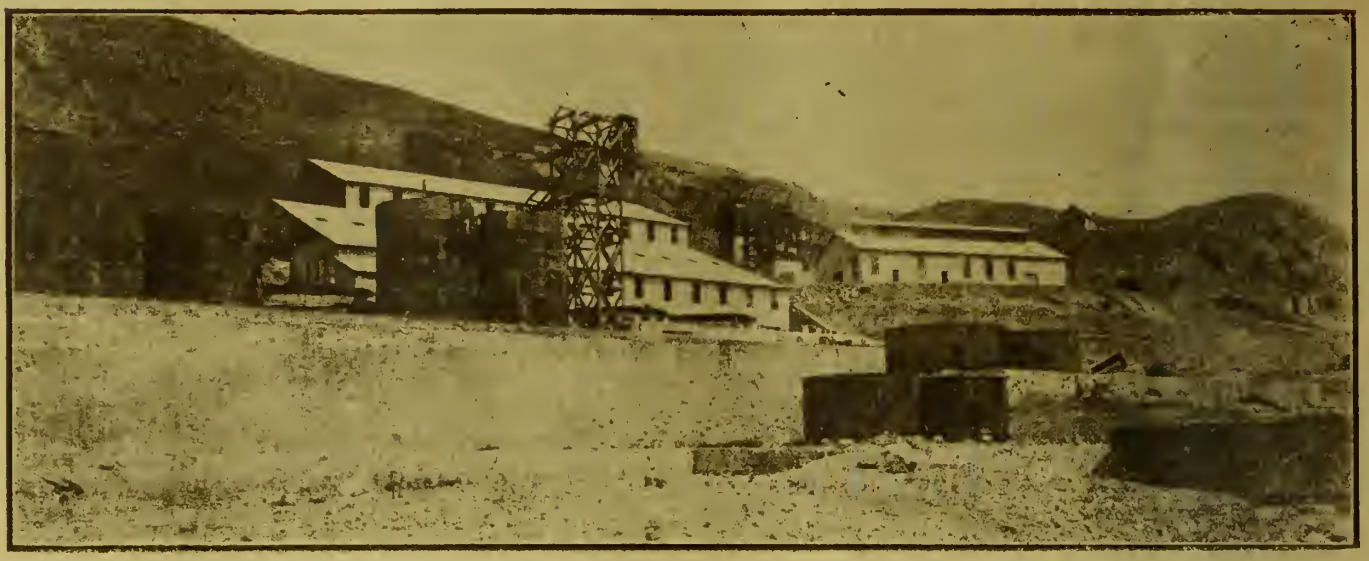
The State of Oaxaca is much more fortunate in falicities for travel and transportation. Until the advent of the Mexican Southern railroad some 15 years ago, the city and mining camps of Oaxaca were distant many days' horseback ride from Puebla, the nearest railroad point, or had a 200-mile pack-haul to Vera Cruz, which was the port to which the early mining companies had to send their rich ores or bullion for shipment to England. So truly were the people of Oaxaca cut off from the outside world that the language spoken here today is noticeable for its colloquialisms or 'patois,' differing enough from the Spanish of other parts of the Republic so that an Oaxaquenean may be known by his speech. In spite of its isolation, however, the early records of the pioneer companies make a wonderful showing of metals produced, all done by the crudest methods. A number of old "Haciendas de Beneficio" are still standing, inert and deserted, with the old wooden stamps and wooden overshot wheel fast falling into decay, monuments to the sturdy character of the early English and German pioneers.

The mineral zone of Oaxaca is principally embraced in a circle with a radius of about 50 miles, having the city of Oaxaca as the centre. The principal districts are those of Ejutla, Taviche, Ocotlán, Sierra Juarez, Magdalena, and Penoles. These are generally known locally by slightly different names. Others, a little more distant, are El Parién, Tololapám, and Teojomulco.

The conditions in 1907 were such that the mines in general were over-capitalized and under-developed. Owners of mines and prospects alike had an exaggerated idea of the value of their properties, and many groups of claims of doubtful value were taken up, the general idea being that anything would furnish bait for the inexperienced investor. Needless to say, today the conditions are changed. Good prospects can be purchased or bonded for from one-half to one-tenth of thier former estimated value, and many doubtful ones have reverted to the Government, for lack of funds with which to pay the taxes, or because so many really promising prospects, already titled, can be had for low figurse. With the gradual return of prosperity, it is easy to see that a more conservative basis will exist for the new order of things. Heretofere there has been much talk of projected railroads. Now the Mexican Southern railroad has Oaxaca for its southern terminus. It is an English corporation, accredited with the necessary backing.

Much has been said about the quality of the labor to be had in Mexico for mine operations. It is well known that the average mine laborer in Mexico, be he "peon" or "barretero" (common laborer or driller), is more or less an erratic individual. He usually has a strong penchant for holidays, religious or others; he too often likes his "mezcal" or "aguardiente." But there are many virtues about the mine laborer in Mexico. The question of an 8-hour day does not bother him. More often he will work 10 or 12 hours, utilizing time between blasts for his "tortillas" and "frijoles." Work is mostly done under a contract system, where the contractor himself makes a hand, and sees to it that his assistants put in their best licks.

Mexican Views.



Mexican Views.

Early History of Pachuca.

One of the most important mining districts of Mexico is that of Pachuca, in the state of Hidalgo. Among the famous mines there are the Real del Monte, Santa Gertrudis and Xacal. The first discoveries were made in this district, it is said, in 1522 by the Spaniards, within two or three years after the conquest, and they have been worked with more or less vigor ever since. During the first years of their history the development of the mines and the reduction of the ores proceeded slowly, but the introduction of the patio process by Bartolome de Medina, in 1557, to the reduction of the ores of Pachuca district, gave a tremendous impetus to the industry, and the development of the great mines of Pachuca, as well as those of other districts in Mexico, rapidly advanced, and they soon entered upon a period of astonishing success, when all things are considered. One hundred years later these mines were still being operated on an ever increasing scale, the Xacal mine of Pachuca, yielding at that time at the rate of 7000 ozs. silver daily. It is said that La Trinidad mine in a period of 10 years produced $40,000,000, while giving employment to 1000 men. In time, as the depth of the mine workings increased, water began to be troublesome and seriously interfered with operations. The greater part of the water was raised from the workings by means of the malacate.

About 1749 a native miner named Bustamente started an adit to drain the Viscaina vein at Pachuca. It required several years to accomplish this, but at a distance of 9000 ft. from the tunnel entrance the great vein was reached at a depth of about 600 ft. from the surface, opening a large mass of high-grade ore. In this great undertaking Bustamente was aided by Pedro Terreros, who was obliged to continue the work to completion, Bustamante not living to see the great drainage adit finished. Tererros took from this ore body within the next 12 years over $6,000,000. He made magnificent presents to the court at Madrid, and was knighted by Charles III., to whom he presented two fully-equipped and armed ships of war, one of which mounted 112 guns. Terreros also loaned to King Charles about $1,000,000, which his majesty failed to repay. On the decease of Terreros (Count Regla), his heir, the second Count Regla, continued to work the property, but he soon carried the workings below the drainage level, the upper portion of the great deposit having been exhausted. Water became very troublesome and finally, according to an old report, 1200 horses were required to hoist the water from the mine workings. The expense for handling the water alone exceeded $250,000 annually. Under these difficulties minin was carried on for several years, conditions becoming steadily worse, until at a depth of 325 ft. below the drainage tunnel work was abandoned, the mine workings filled with water up to the level of the adit and the property remained idle for a long time.

This was practically its condition when the English Real del Monte Co. was organized in London for the purpose of buying a number of the famous old mines of the Pachuca district, among them properties on the Viscaina vein. The engineers of the new Real del Monte Co. very naturally supposed that the methods of the Mexican miners were crude, and had been inadequate, and that all that really was required was heavy pumping machinery, when the old workings would be relieved of water and the famous ore bodies rendered once more accessible, with large profit to the new owners. This company operated the great mine for 23 years, expending nearly $15,500,000, the gross output during that period being but $10,481,000 —a loss of about $5,000,000.

The first installation of machinery included two steam engines, each having 36-in cylinders, to furnish power to operate the big pump which freed the workings of water down to the old lowest workings, 325 ft. below the drainage tunnel. Here the two great engines became unable to handle the ever-increasing volume of water to a greater depth, and a new engine with 54-in. cylinder was added to the plant. This permitted the continuance of work to the depth of 724 ft. below the adit, at which level it again became necessary to increase the power, and a fourth engine, this time with a cylinder of 75-in. diameter was installed. During these years of unprofitable operation three large bodies of ore had been found and worked out, yet the company had lost about $5,000,000 directly in the operation, in addition to a first investment of nearly $2,000,000, and this, together with other losses which brought the total loss to about $11,000,000 caused the mines to be closed and the company to disorganize. Shares in Real del Monte in 1825 were in demand at $8000 each. In 1845, 20 years later these same shares went begging at 30 cts. per share. The entire property was sold about 1848 for $130,000, of which amount the English bondholders received only about 25 per cent, the balance going to settle outstanding native claims at Pachuca.

Not long after the Real del Monte Co. dissolved, a new company was organized to operate at Pachuca, and work on the Rosario soon began. This venture was successful, and led to the resumption of work on the Xacal vein, the workings of which quickly entered bonanza. The Santa Gertrudis bonanza was discovered in 1879, and soon thereafter a rich find was made on the San Rafael. Pachuca has now become one of the most important mining districts, not only of Mexico, but of the world. So much has been written of its later history that it seems unnecessary to repeat it here.

Great claims are made for a new alloy the basis of which is a mixture of cobalt and chromium. It is said to have the toughness and malleability of steel and to take a high polish resisting in a remarkable degree the action of corrosive agents. In combination with other metals it can be hardened so that it scratches glass and the hardest steel. In tests made with cutting tools made of the alloy the material showed an advantage over the best high speed steels. While a steel tool turned on a lathe four cast-iron plugs without regrinding, a tool made from the alloy turned up 159 similar plugs at the same speed.

Thomas A. Edison considers the discovery that ammonia can be produced by passing hydrogen and nitrogen over hot iron the greatest recent achievement of science. If it can be done simply enough that certainly is a great discovery, for ammonia, besides being itself a great fertilizer, can be easily oxidized to nitric acid, and is a raw material in the most approved process for the manufacture of cyanide.

There is one peculiarity of a shunt-wound motor as commonly used which is not always recognized, says Power. When the motor is operating "cold" (before the load has been on long enough for the motor to warm up) the speed is from 4 to 5 per cent lower than after the motor is warm. This is due to the lower resistance of the fields when cold.

New Publications.

Testing of Hydrometers. Washington, D. C.; U. S. Bureau of Standards. Circular No. 16; pp. illustrated.

Testing Potential Tranformers. By H. B. Brooks. Washington, D. C.; U. S. Bureau of Standards. Scientific Paper No. 217; pp. 8; illustrated.

Factors Governing the Combustion of Coal in Bolier Furnaces.—A Preliminary Report. B J. K. Clement, J. C. W. Frazer and C. E. Augustine. Washington, D. C.; U. S. Bureau of Mines. Technical Paper 63; pp. 46; illustated.

This report embodies the results of a series of 23 tests of Pocahontas coal made by the Bureau of Mines. In these tests the rate of firing was varied from 20 to 65 lbs. of coal per square foot of grate area per hour, and the air supply was varied from 10 to 20 lbs. of air per pound of combustible.

Report of the Minister of Mines of British Columbia for the Year Ending December 31, 1913. By Richard McBride. Victoria, B. C., Canada. Pp. 459; illustrated.

Determination of Ammonia in Illuminating Gas. By J. D. Edwards. Washington, D. C.; U. S. Bureau of Mines. Technologic Paper No. 34; pp. 23; illustrated.

Electric Lights for Use About Oil and Gas Wells. By H. H. Clark. Washington, D. C.; U. S. Bureau of Mines Technical Paper 79, Petroleum Techonology 19; pp. 8.

Mine Sampling and Valuing. By C. S. Herzig. With a chapter on Sampling Placer Deposits, by Chester Wells Purington. San Francisco; Mining and Scientific Press. Pp. 163; illustrated. $2.

This work, though condensed, is an excellent and practical treatise on the important subjects covered by the title. It is adapted to the use of the professional mining engineer and the student. It presents many details not easily accessible in existing textbooks and which are usually slighted in schools. The book is divided into two parts— Part I, Mine Sampling, and Part II, Mine Valuing. There are 20 chapters treating of the following subjects: Principles underlying mine sampling and valuing; definition of ore; sampling for valuation, pick analysis, implements used in sampling; general methods of sampling; precautions necessary in sampling; geological factors in sampling and valuation; churn drilling as applied in sampling; handling samples; preparation of samples for assay; assaying of samples; estimation of ore; calculation of averages, etc.; ore in sight; calculation of profits; amortization of capital; writing reports; salting; prospects; special cases; specific gravity; sampling of placer deposits.

Igneous Rocks and Their Origin. By Reginald Aldworth Daly. New York; Mc Graw-Hill Book Co. Pp 563; illustrated. $4.

In the publication of this work, Professor Daly has made an original, interesting and valuable contribution to the literature on igneous rocks. He has allowed his imagination free play, and, while all of his conclusions may not be acceptable, he has indicated paths for future research well worth following. The book gives the substance of a course of lectures prepared for students of Harvard University and of Massachusetts Institute of Technology and is intended to summarize emphasis on their field relations. The work is divided into three parts. The first of these broadly considers the facts which need explanation in a philosophy of the igneous rocks; the second contains a general eclectic theory on the subject, and the third outlines the results of applying the general theory to the facts so far determined. The author uses the Rosenbusch classification to which he attempts to give a quantitative character by calculating average chemical compositions for each rock type, a point which is open to criticism. In considering the cosmical aspects of the earth the author is inclined to favor the planetesimal hypothesis of Chamberlain and Moulton, although he does not commit himself entirely to it. He believes the earth's crust to be made up of a series of concentric shells, first, the outer thin sedimentary shell; second, an acid or granitic shell; and, third, a basaltic or gabbroidal shell, or sub stratum. This basaltic magma, the author assumes, through tremendous tension becomes cracked and molten wedges are forces toward the earth's surface and react with the materials in the outer shells to produce the various kinds of igneous rocks met with. In part three the author reviews many occurrences of igneous rocks belonging to different "clans," in the light of the theories advanced. Although there is much in this book that we cannot readily accept it will appeal strongly to thoughtful geologists.

Electric zinc smelting has of late years received much attention, but it cannot yet be said to have reached a stage where it can be regarded as a serious competitor of the old muffle process. It is essentially an electric heating process and it labors under the disadvantage of all electric heating processes, in that the price of current must be very low in order to be able to compete with processes which utilize the heat of carbon combustion. Much improvement must also be made in the prevention of metal loss and in the production of an excess of dust. In a few favored localities in Europe electric zinc works have been installed, but even with extremely cheap power the results have not been entirely satisfactory. In the United States particular attention has been devoted to direct smelting in the electric furnace of simple as well as complex zinc ores without preliminary treatment but so far all attempts is this direction have given more or less disappointing results.

Millmen frequently wonder why the Lake Superior copper camps persist in their standard crushing practice, jaw crushers and steam stamps, no matter what changes may be adopted for performing similar operations elsewhere. The explanation is that the copper there occurs in the form of native metal in particles varying in size from masses weighing several tons to microscopic grains. The large masses more than 4 to 6 in. in dimensions are sorted out by hand. If a mass too large to pass through the crusher jaws finds its way into the feed it can easily be removed, while it might put a gyratory machine out of business. Masses small enough to pass the crusher discharge would prove extremely troublesome when fed to rolls or stamps of the ordinary design. With the immense steam stamps they would also prove troublesome if allowed to accumulate in the mortar. To obviate this difficulty the mortar is made more roomy than would otherwise be necessary and is fitted with an ingenious device for removing the mass copper without wearing it away and passing it through the screens. A 5-in. pipe opening in the bottom admits a flow of water under sufficient pressure to prevent the accumulation of rock but not sufficient to prevent the entrance of copper masses. The opening of a valve from time to time removes the malleable masses, and frees the mortar for its proper duties.

In a Lake Superior copper concentration mill where a large number of Hardinge mills are employed, each mill is driven by Wuest gearing by its own motor, and the entire floor is served by a crane capable of lifting out of place either a mill or a motor. Spare mills and motors are kept in readiness at one end of the building, and when a mill or motor requires attention it is simple lifted out of the way and the spare introduced. A concrete stand for the repair of mills is provided near the end of the crane travel. It is said that a motor can be replaced in a few minutes. In the case of a mill it is lifted out and its contents poured into a waiting mill and placed on the stand for repairs, all within the space of 25 minutes.

H. C. Hoover states in his "Principles of Mining" "It must be remembered that the whole theory of estimation by sampling is founded upon certain assumptions as to evenness or continuity and transition in value and volume. It is a basis for an estimate, and an estimate is not a statement of fact."

PATIO.

The deepest metal mine in the world is in Brazil. It is the St. John del Rey mine and has a vertical depth of 5711 feet.

Two and eight-tenths per cent of the earth's crust is estimated to consist of potassium oxide. It is an important constituent of feldspar, granite and other igneous rocks. Potash is valuable commercially in a water-soluble form. In igneous rocks it is locked so tightly that it is of little value and no utilization in a commercial way has been made of these insoluble forms. Potash in water-soluble form is found in large deposits in Germany; in smaller deposits in Austria and Spain; and in brines in some of the arid basins in the western United States. The deposits in Germany, Austria and Spain are concentrations from sea waters containing potash derived from the desomposition of potash-bearing rocks.

A wire rope is an expensive piece of machinery and deserves all the care bestowed upon mechanisms made up of bearings and pulleys instead of a simple arrangement of wires. A common cause of wire-rope trouble is kinking, with the consequent shortened life and weakening of the kinked section. This can be avoided by the exercise of the simplest care. A cause of trouble not quite so obvious but equally common is the neglect of lubrication. Wire-rope when used in hoisting or transmission has a multitude of moving parts. There is the friction between the outer skin wires and the sheaves, drums, etc., and quite as important the friction among the inside wires and strands. Good lubrication is essential to the life of the rope, and proper care should be used in selecting the lubricant. It should protect the wires from both wear and corrosion. For this reason some of the cheaper oils are useless for they contain corrosive substances which weaken the wires instead of protecting them from rust.

The French geologist, Lacroix, has for years been studying deposit sdue to the decomposition of rocks in tropical climates. Among these are important beds of iron ores in Cuba and Brazil. He defines a laterite as the products of decomposition of all rocks containing silicates of alumine, and which from the chemical point of view, are characterized by the predominance of the hydroxides of alumina and iron generally with the oxide of titanium, after the elimination, more or less complete, of the other elements of the original rock: alkalies, lime, magnesia and silica.

The storage battery locomotive for mine haulage offers a number of advantages. It does away with the dangerous trolley wire. When drifts are on the sill floor of the stopes, where timbers are often broken and bulged by reason of the weigth of the filling above, there is always danger of the men coming in contact with low hanging trolleys. Another feaure is the easy access to the face of the drift. There is no trolley wire to blast against and break and the time necessary for repairs. And with the storage locomotive it is not necessary to hunt up the electrician to make the necessary extension of trolley as the work advances. The cost of installation and upkeep of trolley wires is saved, and no provision for return of current is needed, and no danger of electrolysis of pipes, etc., from faulty connections.

France has produced briquets from fine coal on a commercial scale since the year 1842. The industry has grown to such magnitude that the production during 1913 exceeded 36,000,000 short tons. Briquets produced in Great Britain are used principally for steam purposes and the greater part of the output is either exported or bought by the governmen for use in the navy. On the continent the briquets are sold in all branches of the coal trade. The French railways consume from 16 to 40 per cent of their fuel in briquet form, and in Germany 20,00,000 tons of lignite briquets were during 1913 used for household fuel.

E. N. Brown has made an exhaustive study of the colloid, gelatinous and plastic states of finely divided minerals. He makes the following points and conclusions: Clean crystalline rock powders do not develop plasticity on the addition of water, no matter how fine they may be ground in the dry state. Such powders if ground in water for a long time do develop plasticity. Those powders containing minerals least easily attacked by water, such as quartz and feldspar, develop the least placticity. Water exerts a solvent action on the mineral grains, resulting in colloid and true solution, the colloid modifications remaining as coagulated sols, gelatinous coatings over the mineral grains. Organic gels increase the viscosity of the water films in mineral powders, the effect being apparently more pronounced than that of equal amounts of inorganic gels. The amount of gel matter present in clay depends on the past history of the deposit. Clays are simply the weathering products of crystalline rocks in which the most soluble constituents have been removed, leaving behind more resistant secondary products with gelatinous coatings. The most highly plastic clays are those that have been subjected to the action of water for long periods. Residual clays are of low plasticity, but water-transported kaolins of exactly the same composition are quite plastic. Plasticity in clay is due to a gelatinous state of matter, a state common to them because of their mode of origin. This gelatinous matter may be silicic acid gel, alumina gel, iron oxide gels, silicate gels or organic gels. Two or more of these are usually present, and their effect will be further modified by absorbed salts and the relative proportion of large and small grains, and to a limited extent by the shape of the grains.

The question of petroleum and altitude is still little understood. The Mexican oil fields are all below 1000 feet, but in Peru oil is produced at an altitude above sea-level of 13,000 feet, and in Wyoming and Colorado at altitudes above 7000 feet. Petroleum is not supposed to originate in sand, but in shale or limestone, whence it migrates to a sand or porous sandstone which acts as a reservoir. Oil sand is merely any porous rock impregnated with petroleum.

Fullers earth may be classed as a clay, a hydrous alumina silicate, which through selective absorption has the ability to bleach, clarify and purify liquids with which it comes in contact. A colloid has the power to absorb selectively and to bleach, and as hydrous alumina silicate enters into the colloidal state it is supposed that the bleaching power of fullers earth is due to its high colloidal content.

Nickel is of great importance in the manufacture of nickel steel, but the greater proportion is still used in the production of nickel brass known as German silver, which forms the basis of all plated silver table are. The Canadian Copper Co. Sudbury, Canada, produces the largest quantity of nickel, having an annual output uf 22,000 short tons. The Mond Nickel Co. smelts ores to mattes equal to 2600 tons of nickel; the Societe du Nickel with other companies in New Caledonia ships 800 tons; Norway raises ores producing 400 tons; and Prussia extracts about 1000 tons of nickel. Canada expots nickel in the form of matte containing about 50 per cent of that metal and 25 per cent copper, to Constable Hook, New York, where the matte is refined by the International Co. The Mond Nickel Co. ships its mattes to Swansea for reduction, while the ores and mattes derived from New Caledonia are sent partly to France parttly to Germany. The Norway ores are refined at Christiansand. The annual production of the metal is distributed about as follows: United States, 22,000 tons; Germany, 4400 tons; Great Britain, 2600 tons; France, 1900 tons; Norway, 400 tons. Of the 22,000 tons produced in the United States in 1913, 14,000 tons were exported. Nickel steel contains from 3 to 4 per cent of the metal.

Heat increases the speed of hardening concrete. Setting by steam has been successfully employed in constructing the 27-mile concrete pipe line from Sooke Harbor to Vancouver B. C. The pipe is constructed in sections, each section being immersed in live steam for 24 hours, the steam causing the concrete to set as well as would otherwise be obtained by a month's exposure to the air at ordinary temperatures.

The size of product passed through a wire screen with square holes is not the

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same as that passed through a round-hole screen of the same diameter of opening. In tests made recently at Platteville, Wis. it was found that if one screens material through a screen of wire cloth having a square opening of one millimeter it is equivalent to screening through round perforations 1.23 millimeters in diameter.

The cost per ton of ore for cyaniding will depend upon many conditions which vary with each plant and each mine. The first cost for installation depends largely upon facilities for transportation and the character of machinery installed. A large item in ore treatment is crushing, the cost of which will vary with the hardness and toughness of the ore, the fineness to which it is to be ground and the type of crushing machinery to be employed. All-slime mills necessarily consume more power for grinding than coarse crushing and leaching mills. The cost for chemicals and supplies varies with the character of the ore and the facilities for transportation. Cost for labor depends upon the locality, and the system of treatment employed in the mill. It should also be borne in mind that low cost does not necessarily imply efficiency. A cheap installation and a cheap process may involve low extraction and a lower money return per ton of ore.

In September, 1914, in the Rand district, Transvall, there were 9296 stamps at work and 283 tube-mills, the duty per stamp being 8.9 tons per 24 hours. The use of cone classifiers is not decreasing, but on the contrary is being extended in some cases. Nissen stamps are finding a limited use.

A new detinning process depends for its action upon the change of an adherent white tin coating to a gray form which does not adhere closely. The change is brought about by the catalytic action of gray tin applied in the form of a slimy mixture with a solution of tin-ammonium chloride. A mixture of about 2500 lb. of gray tin is used with a solution of 10 lb. of tin ammonium chloride in 100 gal. of water. Agitation may be used, or the coated material may be merely moved through the mixture.

It has been calculated that the mean density, or specific gravity, of the earth is between 5 and 6, while that of the rocks at the surface is only about 2.5 to 2.70. At 250 miles in depth the density is figured at 3.1; 2000 miles, half way to the center, at 7.5 and at 4000 miles, the center 9.8. Le Conte places the density at the center much higher, i. e. 14.5. It does not appear that pressure alone can account for such increased density in depth, and it is believed that the mass at the center of the earth contains a much larger proportion of metals than the rocks which constitute the crust.

PERSONALS.

Carl Draper, formerly at San Miguel del Oro, Zacatecas, is now in San Francisco.

Charles Hoyle, manager of the Esperanza Mining Co. has returned to Mexico after a trip to the company's properties.

D. C. Brown, manager of the Compania Metallurgica Mexicana, is in New York.

Chas McC. Anderson of the Mexican Mining Journal is on a tour of the States. He will visit New York, Milwaukee and El Paso before returning to Mexico.

P. A. Babb, of Pachuca, has been in Mexico city on company business.

Paul W. Avery, metallurgist of the Esperanza Mining Co., El Oro, has returned to his post.

E. C. Hall, formerly with the Amparo Mining Co., Jalisco, is in Mexico City.

Percy Stockdale, formerly of Pachuca and lately with the Cinco Minas Co., Jalisco, has gone to San Francisco.

W. Howard, assistant manager of the Amparo Mining Co., Jalisco, is in the States purchasing supplies.

Chas. Bosdet, long a resident of Guanajuato, is now in Canada.

W. D. Rogers, auditor of the Cinco Minas Co. is in San Francisco buying supplies.

Geo. W. Edmond is mill foreman at Cinco Minas, Jalisco.

Dr. Spence of Guadalajara has left for the U. S.

L. F. Carrouche is in San Jose, Cal.

R. A. Corcoran, of Santa Gertrudis, Pachuca, was in Mexico City last month.

A. W. Hahn has completed his work at Pachuca and returned to the States.

H. A. Kruger has resigned his position with the Santa Gertrudis Co. and is now at Joplin, Mo.

E. W. Funston is in the States.

Arthur Hunter has returned to Taxco, Guerrero.

Geo. A. Morrison, manager of the Republic Mining and Metal Co., has gone to San Luis Potosi on company business.

Wm. Carroll is in Cuba.

W. E. Eells, of the Metallurgica, San Luis Potosi, is in Texarcana.

William Oliver, of the Real del Monte Co. was a visitor the Mexico City during the past month.

J. A. Davidson of Pachuca has left to join the British forces at the front.

D. S. Calland, manager of the Real del Monte Co. has been in Mexico City.

R. M. Geppert, of the London office of Esperanza Ltd., has been in Mexico looking after company affairs.

Amasa D. Sproat, of Santa Gertrudis, Pachuca, has returned to his post after a brief visit to Mexico City.

Spencer N. Cook has left Santa Barbara, Chi., for Fresnillo, Zac.

A. J. Eveland has severed his connection with the Santa Gertrudis Co. Pachuca, and is now in the United States.

TRADE NOTES

The Hardinge Conical Mill Co. announces that the Calumet & Hecla Mining Co. has completed the installation of 12 large Hardinge mills in its new plant at the White Pine mine.

The Wood Drill Works, Paterson, New Jersey, publishes a leaflet on the 'Brownie' drill. This machine weighs 83 lb. and the tripod 65 lb., a one-man drill. It is designed especially for breaking up boulders for crusher and road work, small tunnels, and sewers, and will drill to 8 ft. The cylinder and chest is of vanadium-tungsten iron. A complete outfit, with set of steels to 7 ft. and dressing tools, is $125 f.o.b. Paterson.

The Harbison-Walker Refractories Co., of Pittsburgh, has just distributed an interesting and well arranged booklet of 113 pages, entitled 'A Study of the Malleable Furnace.' The six chapters, with illustrations, cover the following: characteristics of malleable iron, properties, process of manufacture, furnace construction, operation, micro-structure of malleable cast iron with a number of micro-photos and analyses, and a record of a typical heat. All iron workers should secure a copy of this useful book.

The Orenstein-Arthus Koppel Co., of Koppel, Penn., has just perfected a new locomotive embodying two distinctly new feaures, flexible diamond shaped trolley and a double truck, permitting the use of the car on track layouts where sharp curves are encountered. It can take a curve of even 12-ft. radius while hauling a train, without excessive power being required and without derailment.

The Westinghouse Electric & Manufacturing Co. has just issued a preliminary statement of a liberal plan covering sickness and accident relief, accident compesation and service pensions. The relief department is maintained by the employes by the payment of small monthly dues, but all dues are used for benefit payments, the company paying the operating expenses of the department. It also duplicates the employees' contributions for death benefits. The accident compensation plan covers total and partial disability and death. For total disability the company pays two-thirds wages during its entire duration; for partial disability it pays an amount equal to two-thirds of the reduction in earning power. The pension system provides for retirement at 70, and for those who are members of the relief department and have completed 20 years of continuous service are to be granted a pension of 1 per cent of their average monthly wages during the last 10 years, for each year of continuous service, with a minimum of $20 per month and a maximum of $100. Widow's and dependent children's pension are also provided for.

"Cochrane Multiport Valves"—A booklet of 72 pages, just issued by the Harrison Safety Boiler Works, Philadelphia, Penn., describing the multiport valves introduced by that company for back pressure, relief and vacuum service, flow service in connection with mixed flow turbines, and checkvalve service with bleeder or extraction turbines. The essential idea of the multiport valve is the use of a number of small disks instead of one large disk, in order to secure greater safety, quietness, lightness of moving parts, and tightness.

Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, in Bulletin No. 1088, describes the distributing transformer manufactured by this Company. Among the features claimed for this transformer are three cooling surfaces in place of one as usually employed, a continuous natural circulation of oil, and a low operating temperature. The bulletin is fully illustrated and shows in detail the construction and operation of this type of transformer. Bulletin No. 1089 is devoted to the reversing motor planer drive. The motor as used for this work is automatically reversed at the end of the cutting and return strokes. In the design of this motor no effort has been spared to provide apparatus which will be the best for the particular character of the work to be performed. Bulletuin No. 1090 is devoted to motor-generator sets. The motor-generator set is a convenient means of transforming or converting electrical energy from one form to another.

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.578
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59 207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.861	58.175	28.038	27.825	26.704
June	61.290	58.690	58.471	28.215	27.166	26.948
July	60.954	56.721	54.676	27.619	27.074	25.216
August	61.606	56.263	54.344	28.375	27.335	25.679
September	63.078	60.840	53 260	29.066	27.966	24.260
October	63.471	60.763	50.654	29.299	28.083	23.199
November	62.762	56.995	49.062	26.012	27.263	22.703
December	63.365	57.760	.....	29.320	26.720	.....
Total	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

MONTH	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	64.131	14.930	.....	65.329	69.170
April	15.291	64.211	15.565	.....	68.111	69.313
May	15.436	63.996	15.738	.....	68.807	67.786
June	14.672	61.603	14.971	.....	67.140	66.274
July	14.190	13.223	14.583	.....	64.166	64.955
August	15.400	.....	15.904	.....	69.200	53.227
September	19.326	.....	16.799	.....	73.125	.....
October	18.337	.....	16.913	.....	73.383	.....
November	15.192	11.739	19.022	.....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Total	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound. London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1913	1914	1913	1914
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.555
March	46.832	38.038	213.615	173.619
April	49.115	36.154	224.159	163 862
May	49.038	33.360	224.143	150 702
June	44.820	30.577	207.208	136.321
July	40.260	31.707	183.511	142.517
August	41.582	.....	188.731	.....
September	42.410	32.675	193.074	.....
October	40.462	30.284	184.837	.....
November	39.810	33.304	180.869	139.391
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound terling per long ton.

LEAD

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4 171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.950	16.977	19.651
April	4.381	3.910	4.242	3.863	17.597	18.225
May	4.342	3 900	4.226	3.863	18.923	18.503
June	4.325	3.900	4.190	3.810	20.226	19.411
July	4.353	3.861	4.223	3.736	20.036	19.051
August	4.824	3.875	4.550	3.715	20.408	
September	4.668	3 926	4.570	3.858	20.646	
October	4.402	3.529	4.253	3.364	20.302	
November	4.293	3.693	4.146	3.595	19.334	18.500
December	4.047		3.929		17.798	
Year	4.370		4.238		18.743	

New York and St. Louis, cents per pound. London pounds sterling per long ton.

SPELTER

MONTH	New York		St. Louis		London	
	1913	1914	1913	1914	1931	1914
January	6.931	5.262	6.854	5.112	26.114 25.338	21.583
February	6.239	5.377	6.089	5.227	24.605	21.413
March	6.078	5.220	5.926	5.100	27.318	21.460
April	5.641	5.113	5.491	4.963	24.583	21.569
May	5.406	5.074	5.256	4.924	22.143	21.393
June	5.124	5.000	4.974	4.850	20.592	21.345
July	5.276	4.820	5.129	4.770	20.706	21,586
August	5.956	5.589	5.508	5.418	21.148	
September	5.694	5.390	5.444	4.230	20.914	
October	5.340	4.906	5.198	4.750	20.561	
November	5.229	5.112	5.083	4.962	21.214	25.016
December	5.156		.004			
Year	5.648		5.504		22.746	

New York and St. Louis, cents per pound- London pounds sterling per long ton.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

AMERICAN SOCIETY OF MEXICO.

The Society of the American Colony of Mexico City has been reorganized on broader lines, under the name of "The American Society of Mexico."

At a mass meeting recently held in the City of Mexico a new Board of Directors was elected, together with the following named officers: President: R. M. Raymond; Vice President, Dr. Sidney Ulfelder; Secretary, J. D. Helm; and Treasurer S. S. Conger.

At a later meeting the Society adopted a new Constitution and By Laws, providing for permanent organization. This is broad in scope, to cover present and future needs.

The object of the Society as stated, is to promote the welfare of the American residents of the Republic of Mexico. Among other powers the Society is authorized to take cognizance of and act upon all subjects of general interest of its members; to promote and establish mutual cooperative relations; to cooperate with and assist other American institutions of Mexico; to provide, when expedient, a home or house for the accommodation of its members; and to acquire property when desirable for the uses of the Society.

All properly recommended nationals of the United States of America, either men or women residents of the Republic of Mexico, may become members of the Society by signing cards of registration.

The principal office of the Society is to be in the City of Mexico, but branch offices may be established elsewhere.

Heretofore the membership has been limited to men, but in the reorganization the women are invited to join. The present membership of about 1,300 will at once be largely increased.

A cordial invitation is extended to all Americans, men and women, throughout the Republic to identify themselves with this movement for mutual benefit. Naturally the Society will be non-political and non-sectarian. It is also entirely democratic and requires of applicants nothing more than a recommendation as to good character.

It is hoped that Americans of all occupations throughout the Republic will recognize the importance of such an organization and will identify themselves with it. If they do real benefits can be secured for all concerned.

There is need for a strong Society and better opportunities for acquaintance than have heretofere existed among the Americans so widely scattered over this great and undeveloped country. It is important that more and reliable information be had of the Americans living in Mexico, and that a common channel of communication be provided for various purposes. This will give an opportunity for united expression of sentiment and united action in matters relating to the common good. It will make possible a registration of American residents that has not existed heretofore.

When the plans are fully developed in the course of time the Society will be able to provide a Club or meeting place for Americans from all parts of the Republic when they visit the capital; meantime it can be made useful as a source of information to non-resident members.

All who feel an interest are invited to correspond with.

J. D. HELM, Secretary.

408 LA MUTUA, MEXICO, D. F.

Shafts of circular section are coming into use on the Rand especially for the deep mines. The circular form combines strength of structure and convenience for excluding water encountered in the course of sinking. It requires permanent walls which may or may not render it more costly that the shaft of rectangular section. A circular shaft has more waste space which can be utilized of ventilation, piping, ladder ways, etc. The walls of this form offer less friction surface to the passage of air than the timbered surfaces of the rectangular shaft. In sinking operations the circular shafts offer better facilities for breaking and handling rock, owing to the fact that the sump is carried down the center and that with the exception of the holes around the periphery all holes are pitched toward the center. Thus the broken rock is centred around the bucket which is a considerable advantage in mucking. In sampling ground with the churn drill care must be taken to ensure that the casing goes down at least as fast as the drill to prevent the inclusion in the sample of more material than the dimensions of the casing pipe represents. In order to accomplish this it may be necessary to drive the casing ahead of the drill. This may be done by raising the string of drill rods so that the bit does not strike the bottom, and attaching a dog at such a point on the rod that it strikes the driving collar of the casing.

Connersville Blower Co., Connersville, Ind., Catalog No. 16 Connersville Cycloidal Pumps. 48 pp., illus., 9x12 inches. This catalog, prefaced by a short account of "More than 20 Years of Successful Manufacturing," reviewing the steady growth of the Connersville Blower Co.'s business, deals especially with this company's line of two-impeller cycloidal rotary pumps, used in power houses for circulating pumps, in irrigation work and other low-lift service. The catalog is handsomely illustrated with half-tone illustrations of actual installations, and diagrams both of two-lobe and three-lobe impellers, the latter type being adapted to higher lifts.

Flowing wells due to water pressure have long been known as artesian, but that term has become indefinite since it has been applied popularly to any deep well, and is used industrially for all bored wells in distinctinon from dug wells. Hence the original meaning of artesian has largely fallen into disuse. The Geological Survey of the United States, however, retains the word, "to designate the hydrostatic principle by which confined waters tend to rise in virtue of the pressure of the overlying water column, whether or not this pressure is sufficient to lift the water to the surface and produce a flow."

The Tennessee Copper Co. has the largest sulphuric acid plant in the world, the plant being in operation 350 days a year and turning out from 700 to 820 tons per day. This plant was originally built to take care of the fumes from the copper smelting furnaces, the acid produced being in the nature of a by-product. Now, however, the acid is the main product, the copper being of secondary importance.

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Influencia de la Corriente Eléctrica sobre el mortero y el cemento armado.

Kundson experimentó la influencia de la corriente eléctrica sobre cubos de 30 cm. de lado de la siguiente composición: 1 de cemento, 3 de arena y 3 de piedra. Algunos de los cubos permanecieron 28 días en arena húmeda, otros en agua dulce, en agua de mar y en agua de cal al 1 por 100.

Los primeros grupos se sometieron durante cinco horas diarias a una corriente de 8 amp., los otros a una corriente permenente de 0,1 amp. La experiencia duró de 150 a 300 días. La forma de los electrodos no influía sensiblemente, las variaciones de resistencia eléctrica fueron máximas para los cubos expuestos al aire y mínimo para aquellos sumergidos completamente en agua.

La grieta se manifestó en los cubos sumergidos en agua salada o en agua de cal, y la forma de ésta dependía de la forma de los electrones. El ánodo al final de la operación presentaba herrumbre en tanto que el cátodo presentaba un aspecto brillante. Resultó que las grietas eran producidas por el aumento de volumen del ánodo de hierro a causa del orín, lo cual se demostró reemplazando el hierro por un ánodo de carbón. En los expuestos al aire seco no se constató anormalidad alguna.

La adherencia de la armadura de hierro con el cemento con una corriente continua de 0,1 amp. durante 28 días, aumentó para los cubos expuestos a la humedad de 11 a 37 por 100.

La Industria Minera del Perú.

Su riqueza mineral es el más valioso recurso con que cuenta hoy la República del Perú. Los progresos alcanzados por esta industria durante el año de 1913 debiéronse más a las mejoras introducidas en las Plantas existentes que al aumento en la cantidad de los diferentes minerales explotados.

La producción de cobre fué, como siempre, la más importante de todas. En el total respectivo corresponde un 90 por ciento a las Compañías Cerro de Pasco Mining Co. y Backus & Johnston Co. La primera de ellas produjo el 75 por ciento de todo el cobre obtenido en el país a pesar de que, durante dicho año, se vió obligada a reducir en un 50 por ciento sus fundiciones debido a la escasez de carbón. Sin embargo, la entidad auxiliar de ésta, es decir, la Morococha Mining Co. que actúa en Morococha, aumentó de modo considerable su producción de minerales.

La nueva planta hidro-eléctrica de la Compañía cuya capacidad es de 12,000 caballos de fuerza y la cual se halla instalada en Oroya, principiará a funcionar dentro de muy corto plazo. Los servicios de ella serán utilizados en las secciones de Cerro de Pasco y Morococha y en las minas de carbón pertenecientes a la Compañía y que están situadas en Goyllarisquisga y Quishuarcancha; el consumo de carbón en la Planta de vapor existente en Cerro de Pasco será aminorado y se electrificarán los tranvías que allí mismo prestan servicio.

Según las estadísticas correspondientes, la cantidad de carbón producida por el Perú durante el año que terminó el 30 de Junio de 1913, fué inferior en 56,000 toneladas a la de otros años. La mayor parte del producto fué extraída de las minas de Cerro de Pasco.

Operaciones de las principales Compañías

La Backus & Johnston Co. terminó durante el año dicho sus extensos trabajos de construcción los cuales incluyen una nueva Planta hidro-eléctrica de 2,000 H. P. que está funcionando muy satisfactoriamente. En lo futuro será posible exportar para los Estados Unidos cobre negro en vez de cobre sin purificar y minerales. Esta Compañía maneja no sólo todo el mineral obtenido en sus yacimientos sino que compra el que produce en el distrito de Morococha.

La fundición de plata y cobre perteneciente a Mr. E. E. Fernandini continúa ejecutando sus trabajos con un resultado promedial de 1,500 onzas de plata por tonelada de mineral y 55 por ciento en el cobre. La producción anual se estima en 1.500,000 onzas. Los minerales de plata proceden de las minas de Colquijirca y los de cobre se llevan de Cerro de Pasco.

La exportación de cobre aumentó un tanto debido a los altos precios alcanzados por este metal. La Sociedad Cuivre de Huaron continúa explotando sus propiedades. La región de Ferrobamba ha permanecido inactiva. Varios Sindicatos extranjeros han obtenido el derecho de opción sobre determinados yacimientos existentes en diferentes puntos del país y parece que la venta de ellos ha de llevarse a cabo en breve.

Yacimientos auríferos.

Los yacimientos auríferos existentes en el territorio peruano y muy especialmente determinados depósitos aluviales, han llamado la atención en el extranjero. Tanto en el Norte, cerca al límite con el Ecuador, como en el Sur y en la parte central se están verificando varias exploraciones. Se ha formado una Compañía americana que actuará en el Río Marañón. La escasez de agua ha entorpecido los trabajos de explotación en el Departamento de Puno. Las minas de veta donde se trabajó durante el año referido fueron las siguientes: la New Chucuitambo, situada cerca al Cerro de Pasco, la Andaray Pasco Co. en la Provincia de Condesuyos, la Cotabambas y la Inca Mining Co. en el Departamento de Puno.

Plata y otros minerales.

La explotación de la plata, practicada independientemente de la fundición de cobre, no fué muy activa durante el año dicho. En el Departamento de Ancachs los minerales que contenían más de 150 onzas de plata fueron explotados de preferencia debido al alto precio que alcanzó dicho mineral.

La exportación del vanadio no alcanzó las mismas proporciones que tuvo en otros años. Por el puerto de Chimbote se exportaron 300 toneladas de tungsteno en minerales y en concentrados. La cantidad de bismuto exportada no alcanzó a 200 toneladas y la de zinc fué aún inferior. Se dice que cerca a Canta, punto situado a unas cuantas horas de Lima, fueron descubiertos varios depósitos de estaño, pero aún no ha podido obtenerse una plena confirmación de que existe allí dicho metal.

El Gobierno prestó cuidado especial

a la conservación de las carboneras existentes en el territorio de la República. Parece que este interés del Gobierno en fomentar la producción de aquel combustible obedece a su deseo de facilitar la construcción de vías férreas en dichas regiones. Se han practicado estudios cuidadosos en Hatunhuasi, Oroya, Uancaya Sayan, Oyon y Chechas, puntos que poseen grandes depósitos de carbón. El Gobierno proyecta interesar capitales extranjeros en la explotación de los distritos referidos. Las importaciones anuales de carbón alcanzan un valor total de $1.099,000; la mayor parte de él procede de Inglaterra, Alemania y Australia. Los exportadores americanos quedarán en condiciones de competir favorablemente con los de tales países una vez que el tráfico por el Canal de Panamá se haya regularizado.

Riqueza Mineral de Bolivia.

Los principales depósitos de Bolivia comprenden minerales de estaño, de plata bajo todas sus formas, de cobre, de bismuto, de tungsteno, de oro y de antimonio.

El estaño se encuentra sobre todo al estado de casiterita, pura o asociada a hidratos de hierro, a finitas o chalcofinitas. Se le encuentra algunas veces puro, pero en filones de poca importancia..

Las ruinas de estaño asociado a la plata se encuentran principalmente en las regiones de Oruro, Potosí, La Paz y Cochabamba; existen minas muy importantes (Huanchaca, etc.)

Las minas de plata más antiguas son las de Colquechaca y de Pulacayo, cuya riqueza va ya en disminución.

Se encuentra el cobre al estado nativo, sobre todo en Corocoro. Su contenido varía de 2 y medio a 12 por 100.

En la Provincia de Carangas se encuentran depósitos poco explotados de minerales de plomo, zinc y cobre.

Al Sur de la Provincia de Potosí se explota el bismuto que se haya en venas, en las cuales se encuentra también chalcopirita, wolpamita, casiterita y otros minerales de cobre y plata. En el lecho de los ríos de esta región se encuentran cantidades de bismuto nativo mezclado con cristales de cuarzo y algunas veces con galena.

El oro se encuentra en buenas cantidades, los depósitos de antimonio encierran una buena proporción de minerales auríferos.

El petróleo parece que se encuentra también en buenas cantidades, pero aún no se ha hecho una investigación formal sobre los yacimientos de este combustible.

Acción del Agua del Mar sobre los Cementos.

La disgregación producida por la acción del agua de mar sobre las obras de cemento, llama vivamente la atención de los productores y de los que emplean este material en las construcciones marítimas. No se ha podido establecer con certeza la causa de tal deterioro; se atribuye comúnmente a la reacción del sulfato de magnesio del agua de mar sobre el carbonato de calcio del cemento y sus aluminatos, reacción que origina hidrato de magnesio y sulfo-aluminato de calcio, el cual cristaliza juntamente con numerosas moléculas de agua.

Los demás elementos del agua de mar y del cemento parecen no influir mayormente.

Debe tener presente que los cloruros de sodio y magnesio pueden rápidamente atacar los silicatos.

En vista de que algunas construcciones de este material efectuadas en los Estados Unidos, no han experimentado graves defectos, no sería aventurado creer que la causa del mal reside en la mala ejecución del trabajo, deficiente calidad de la materia prima, choques de cuerpos flotantes y a las acciones de las heladas más que a reacciones químicas seguidas de cristalización, tanto más, cuanto que los deterioros, se producen en la zona de afloramiento, al nivel del agua.

El "Colorado State Agricultural College" en los Estados Unidos, por primera vez examinó este género de disgregación sobre bloques de cemento, después, el "Montana Agricultural College" hizo análogas observaciones sobre los conductos de agua. En tal investigación no se ha llegado todavía a profundizar la causa de los deterioros, habiéndose observado en cambio en el primer caso la eliminación de la sílice y de la alumina, y en el segundo, la formación del sulfo-aluminato de calcio.

Las instalaciones de irrigación proyectadas en los Estados Unidos, han inducido a la "Estructural Materias Laboratories" estudiar esta cuestión tan importante.

El ingeniero C. Humprhrey notó que en todas las obras visitadas por él, las sales alcalinas habían atacado los cementos, las piedras y los ladrillos y que las aguas estaban saturadas de materia salinas de las eflorescencias de los terrenos y de los cementos no atacados.

Entre las sales alcalinas prevalecían el sulfato de magnesia y el sulfato de sodio, y cuanto mayor era la proporción del primero, tanto más era su acción destructora.

Una larga serie de experimentos ejecutó el "Bureau of Standards" ya en los laboratorios, ya en las costas del mar Atlántico. Estos últimos han durado 3 años y medio. La malta de cemento Portland cuando es porosa puede disgregarse con la fuerza mecánica que la cristalización de cualquier sal desarrolla en los poros, si la sal se deposita en suficiente cantidad y si el secado conduce a la rapida formación de los cristales. Cuando la cristalización se produce lentamente. los cristales que se forman son más grandes y las consecuencias son más notables. No sólo los cementos sino también las piedras porosas y los ladrillos sufren esta disgregación.

Por tanto, en los lugares ricos en sales alcalinas es prudente recubrir los materiales con un revestimiento protector denso y no poroso.

Los cementos hidráulicos se disgregan rápidamente cuando son puestos bajo la acción química de los sulfatos y de los cloruros en solución. Pero esto no se verifica más que en experiencias de laboratorio.

En la práctica, la acción es lenta porque la cal del cemento se encuentra carbonatada, formándose en la superficie una costra protectora de depósitos salinos, casi impermeable.

Una malata hecha completamente de Portland, sumergida en agua de mar no sufre alteración. Y parece que sucede lo mismo cuando queda descubierta a marea baja.

No ha sido aun posible establecer si esta resistencia de los cementos a la disgregación química del agua marina, se debe a una capa protectora, formada a expensas de los depósitos orgánicos, a la reacción entre las sales marinas y los elementos constitutivos del cemento que produce eventualmente un compuesto resistente, o más bien, a una y otra causa combinada.

La resistencia de las construcciones marinas situadas por debajo del nivel del agua de mar, parece depender más que de la naturaleza de los materiales, del método de trabajarlos, pues el hormigón fragua y adquiere una perenne resistencia tanto en el agua de mar como en el agua dulce o en el aire, siempre que se pueda substraerlo de la acción del agua de mar durante el empaste.

Tanto los cementos especiales como los ordinarios a medida que el tiempo pasa, aumentan de resistencia ya sea en el agua de mar como en el agua ordinaria.

Tampoco se han comprobado diferencias después de dos años de exposición sea en agua marina, sea en agua dulce, respecto a la resistencia de morteros de

cemento conteniendo un elevado porcentaje de fierro o luminio.

Todos los cementos han resistido a la acción del agua marina mejor en el estado de mezcla que bajo forma de malta de solo cemento.

La propiedad física del cemento depende esencialmente del sistema de fabricación y la resistencia parece estar en relación con las soluciones de sulfatos y cloruros.

Contrariamente a la opinión general, parece no existir una relación aparente entre la composición química de un cemento y la rapidez con la cual actúa sobre el agua de mar. Ningún sulfo-aluminato tricálcico se forma, entonces la disgración no puede provenir de esta causa. En presencia de soluciones mixtas de sulfatos y de cloruros análogos a los del agua de mar el elemento más soluble del cemento es el calcio. Si está en el estado de carbonato es prácticamente insoluble. La cantidad de aluminio, de hierro y de sílice que se encuentra en el cemento no interesan su insolubilidad. La magnesia presente es prácticamente insoluble. La proporción de SO_3 (hasta 1.75 por cien) no interesa la solubilidad, pero según el modo de variar del SO_3, varía la modalidad del endurecimiento.

El agua de mar al contacto del cemento sufre la siguiente modificación: la magnesia precipita en proporción a la solubilidad del calcio existente en el cemento; los sulfatos, que son los agentes más activos de la disgregación, son absorbidos por el cemento; los cloruros influyen de tal modo que resulta más marcada la acción de los sulfatos. La cantidad de cloro y de sodio que contiene en sí el cemento son demasiado débiles para producir una combinación definitiva con el cemento. La cantidad de SO_3 del yeso agregado al cemento para regular el tiempo de fragüe está fijado de modo tan íntima, que no entra ni aun en solución, cuando el cemento está en contacto directo con el agua destilada.

Las armaduras metálicas revestidas de cemento no son atacadas, si el cemento está bien hecho y si el espesor es de 5 cm. por lo menos.

Entre las experiencias hechas, recordemos las siguientes: en los meses de Febrero y Marzo de 1909 fueron puestas en obra en Boston sobre la costa del mar 24 columnas de cemento. En Noviembre de 1912, fueron cambiadas de lugar. Se aprovechó de esta ocasión para ver cuál había sido la acción del mar sobre ellas.

Estas columnas habían sido construídas con mezcla de Portland, arena y piedra en las siguientes proporciones; 1:1:2; 1:2,5:4; 1:3.6.

Después de confeccionadas se dejaron durante 5 días en el agua y luego por espacio de 5 semanas al aire libre.

En seguida se colocaron en el lugar indicado de modo que sus extremidades inferiores estuvieran siempre sumergidas y las superiores siempre fuera del agua. Del examen se comprobó que la mayor parte de las columnas estaban en buen estado.

*El Mercado del Hierro y del Acero ante la Guerra.**

En las últimas semanas toda la organización comercial e industrial ha sido sacudida hasta sus cimientos, el espíritu de empresa de los pueblos llevado a un estado de inercia completa y en la actualidad la colosal máquina del comercio yace sin movimiento. El mercado del hierro y del acero ha quedado en el caos, lo mismo que las demás industrias; y es una extraña anomalía que los grandes sucesos ocurridos en los últimos días sean responsables del presente estado de negocios. Puede decirse que durante 2 años la construcción de armamentos, en una forma u otra, ha sido la base de la industria.

En la actualidad, es difícil establecer claramente la posición del comercio. Las importaciones del continente, que han constituido durante largo tiempo una dura prueba para los manufactureros, se han suspendido, y en este sentido el comercio ha ganado; pero por otra parte, hay una disminución de materiales y minerales para las fábricas y establecimientos, que ha traído por consecuencia el alza de los precios a un nivel que impide los pedidos del extranjero. Será inútil esperar grandes expansiones, mientras las vías marítimas no vuelvan a trabajar con regularidad. Lo más que puede hacerse es ejercitar la paciencia y esperar los acontecimientos de la guerra; tal vez será conveniente examinar las posibilidades de una gran alza en Europa en los mercados del hierro y del acero.

Desde que Alemania, declaró la guerra a lo que es prácticamente el resto del mundo y después que tuvo lugar el primer choque, los competidores comerciales de Alemania trabajan activamente por recuperar los mercados que esta nación tiene en el extranjero.

Sin entrar a apreciar el mérito de este plan de conducta—porque debe recordarse que nuestra gran industria ha resurgido en gran parte por la competencia alemana,—es necesario reconocer, que aunque Alemania salga de la guerra en bancarrota, la tarea no es fácil y ningún país puede llegar y tomar posesión de tales mercados. Basta una ligera ojeada en la historia del comercio alemán para comprender que una nación que se ha colocado en el primer puesto entre los pueblos mercantiles en un espacio de veinticinco años, debe poseer fuerzas y recursos muy grandes y que en un tiempo relativamente corto, el comercio germánico estará explotando el antiguo terreno. En una época en que el odio trasforma todos los sentimientos hacia Alemania, sería antipatriótico decir algo en alabanza de nuestros enemigos teutones. Sería ceguera también si se dejara reconocer que la nación alemana, aparte del aspecto militar, es un gran pueblo mercantil. Su espíritu de empresa es mayor el nuestro.

En Inglaterra nos hemos lamentado mucho tiempo de los potentes métodos del comerciante alemán, sobre todo en el hierro y artículos afines, pero no es dudoso que la queja no sea sino un nuevo tributo que se ofrece a la previsión y a la iniciativa alemanas.

En los países nuevos del mundo—en especial Sud-América, que está en el comienzo de su carrera industrial—el alemán se encuentra siempre en el campo mismo y es inútil que gritemos y nos quejemos, cuando, al llevar nuestras mercaderías, lo encontramos ya ocupado. Al adoptar esta actitud, no queremos dispensar una alabanza desmedida a Alemania, pero también es conveniente que los comerciantes ingleses demuestren en los esfuerzos que deben hacer para conquistar dichos mercados, mayor iniciativa y se establezcan en una posición capaz de resistir al ataque alemán, que seguramente vendrá, a menos que la guerra resulte para ellos una desintegración política y económica, que no parece muy probable.

Establecida la gran posibilidad de que reviva la competencia alemana una vez que salga del desorden en que la mantiene la guerra, no cabe duda de que se presentarán buenas oportunidades a los fabricantes y comerciantes en hierro y acero de nuestro país, que aprovechadas con sagacidad, extenderán las ramificaciones comerciales. En primer lugar, es dudoso que la competencia alemana siga siendo tan aguda en nuestros propios mercados.

El sistema entero de crédito alemán es malo de raíz y precisamente es este sistema el que ha traído como consecuencia que los fabricantes alemanes inunden nuestros mercados con artículos cuyos precios tan bajos no podíamos tomar en cuenta. Como se ha visto, la suspensión de las importaciones nos ha sorprendido con una pequeña existencia de materias para las fábricas, lo cual indica claramente que cada día íbamos quedando más y más subordinados y era cuestión solamente que el contienente nos proveyera de todo lo que necesitamos en este sentido. Sin embargo, la guerra ha hecho caer todo el sistema de crédito alemán y puede suponerse que los manufactureros del otro lado del canal organizarán sus negocios sobre bases completamente diferentes, cuando la paz se haya restablecido.

* Traducido The Mining Jonurnal de Londres.

Datos Estadísticos y Mineros de la República de Colombia, S. A.

Según el informe que acabamos de recibir del señor Secretario de Hacienda de la República Colombiana, los denuncios de minas hechos ante la Gobernación del Departamento de Antioquia del 1o. de Enero de 1910 al 31 de Diciembre de 1914 fueron tres mil ochocientos veintiuno de estos fueron presentados seiscientos noventa y cuato denuncios en el año de 1910; ochocientos ochenta y uno en 1911; ochocientos diez y nueve en 1912; seiscientos ochenta y ocho en 1913 y setecientos treinta y nueve en el año de 1914.

Sobre los anteriores denuncios sólo se expidieron mil ochenta y cinco títulos extendiéndose en el año de 1910 ochenta y siete títulos; en le de 1911 doscientos setenta y tres; en el de 1912 trescientos diez y seis; en el de 1913 doscientos veintidós y en el de 1914 ciento ochenta y siete títulos.

Tanto entre los denuncios como entre los títulos expedidos predominan las propiedades antiguas, ya en forma de aluviones o bien en forma de vetas.

Los datos que preceden han sido temados según el informe referido, de los Libros de Registro originales que reposan en la Secretaría de Hacienda.

Dichos Libros carecen de algunos datos setenta y tres; en el de 1912 cionalidad del denunciante y el de las minas desiertas o abandonadas.

Pero se debe lo primero, a que hasta el 31 de Diciembre de 1914 se adjudicaron minas a nacionales y extranjeros sin distinción alguna; y a pesar de que las adjudicaciones se hacen al presente en la misma forma por orden expresa del Gobierno Nacional, sólo ahora ha venido a exigirse la manifestación de la nacionalidad en el escrito de denuncio, para poder dar cumplimiento al Decreto del Ejecutivo número 1,320 de Noviembre último. Y se debe lo segundo, a que el registro que de ellas se llevara sería deficientísimo, pues se tomaría nota de las declaradas desiertas por el Gobernador, mas no de las que lo están por ministerio de la Ley.

Por último, los Libros de Registro correspondientes a 1910 y a parte de 1911 suministran pocos datos; por eso la deficiencia en las relaciones, que se han llenado, en bien de la edición, con puntos suspensivos.

A continuación insertamos algunos informes que sobre los trabajos de minería llevados a cabo en Colombia, nos da el Boletín de la Sociedad Antioqueña de Ingenieros.

Lo que más resalta en la minería de Antioquia del año pasado es el buen éxito alcanzado en las minas de Pato por la Oroville Mining Co., Sociedad americana, que puede decirse que ha sido la "pioneer" del dragaje en Colombia. Aunque aquí en el interior poco se sabe de estos tabajos, basta leer la prensa americana para convencerse de la importancia de esta explotación, que está llamando la atención a los norteamericanos. Dicha Compañía dispone de grandes elementos y emplea en grande escala la electricidad como fuerza motriz. En el año antepasado exportó unos 250,000 pesos, pero es entendido que en el pasado tuvo semanas verdaderamente felices. Si, como es de esperarse, este buen éxito continúa, pronto veremos el dragaje establecido en la mayor parte de nuestros ríos más bajos.

La Sociedad de Zancudo tuvo un mal año en sus minas, especialmente en el primer semestre, debido al riguroso verano, que a su vez afectó muchas otras minas. Lo más importante del año es la terminación de la cruzada de la Independencia, un túnel de 730 metros de longitud y 4 metros cuadrados de sección, cavado todo en roca dura, con un gasto aproximado de $30, oro por metro corriente, sin contar el montaje de la máquina de aire comprimido. Con diferencia de unos 30 metros se cortaron dos filones potentes bien formados, que hasta ahora no se han ensayado prácticamente para oro libre, pero que dan buen mineral de fundición, hasta de $70 por tonelada. Este trabajo merece los honores de una monografía, que haré después, al conocer mejor el alcance de los filones, pues no falta quien dude de que los tales sirvan para algo.

En materia de metalurgia, en 1914, quedó definitivamente establecido el sistema de elaboración de los mattes ya tratados por cianuración, con hiposulfito de soda, con una buena extracción de plata y algo de oro. El sistema en referencia, a medida que se vaya abaratando la sal, entrará cada vez en nuestra práctica metalúrgica, para aquellos materiales demasiado refractarios a la cianuración y con un tenor alto en plata.

La mina de "La Trinidad," en Santa Rosa de Osos, se puso a flote para unes de 1914, gracias a una buena dirección financiera y técnica, y comienza el año actual dando buenos dividendos. Esta mina, que es una de las más antiguas y constantes de Antioquia, produjo en los tres años pasados 1,050 libras de oro, fuera de los productos de cianuración. Entiendo que fué en "La Trinidad" en donde primero se estableció el sistema de cianuración, y ahora acaba de mejorarse su extracción agregando a la de percoloración una plantita de agitación.

La mina de "La Constancia" se a puesto a la altura de su nombre. Continúa repartiendo un dividendo de $2,000 a $3,00 oro mensuales. Entiendo que en los dos últimos años ha dejado una utilidad líquida de unos $50,000 oro. Cuenta con una planta hidro-eléctrica que da el movimiento, y una pequeña planta de cianuración les permite sacarle más de un 90 por 100 a los concentrados. En el mes de Diciembre último produjo $6,000 oro.

Otra de las minas buenas de Antioquia es la "Clara de la Unión." Dotada actualmente de un montaje antioqueño de 10 pisones, del sistema californiano, esta mina produce unas 30 libras de oro en promedio, más bien más que menos, de unas 300 toneladas de mineral que elabora, por donde se adivina su alto tenor. En el mes de Diciembre produjo $5,000 oro. Le hace falta un montaje para el beneficio de arenas, sea para cianurarlas, o para concentrar jaguas exportables.

Buen año han debido tener las minas de aluvión del Porce, a juzgar por el riguroso verano en que nos hemos pasado el año de 1914. Hoy se nota una tendencia general a no emplear el viejo sistema de explotaciones minúsculas en hoyas, cuyo desagüe se hace casi a mano o con bombas de mano. En muchas de esas pertenencias han establecido el sistema de explotación hidraúlica que ya va entrando en la práctica ordinaria, con buenos rendimientos. Minero que trabaja un elevador hidraúlico o un monitor, difícilmente se resigna a volver a la vieja rutina colonial, fuera de que ya están muy agotados esos recortes riquísimos que dejaron los españoles, y que permitían toda clase de gastos, en cambio de su gran riqueza.

Ya se ha vuelto práctica corriente el considerar como antioqueñas algunas de las minas de Manizales, sobre todo porque sus poseedores y directores son comerciantes de Medellín. Mucha esp.-culación hubo en este mercado con acciones de Manizales, pero al fin y al cabo quedan unas cuantas minas que son verdaderas riquezas.

"La Cascada," por ejemplo, produjo en 1914 la suma de $112,355, producto bruto. Tiene una costosísima planta de cianuración que produce de $1,500 a $2,000 mensuales, porque las arenas son pobreza y no sé si porque la extracción sea baja. En cambio, el mineral tiene unas bonanzas como no las soñaron los más golosos españoles.

Hago mención especial de la Empresa minera de "El Tostado," mina ubicada en Manizales, pero cuya dirección está en Medellín, por haber lanzado al público un informe, que es modelo en su género. Aparece allí un cuadro preñado de buenos datos estadísticos, que deberían tomar como modelo todas nuestras empresas mineras, y según el cual se trituraron en 1914, 1,443 toneladas, con un tenor medio de 30 1/2 gramos por tonelada, un gasto de elaboración de $5.56, y con un producto de $14.67 por tonelada. Sólo le hace falta al cuadro la debida separación de los gastos en dos: numerario y útiles y materiales, pues estimo que esta partida merece especial atención entre nosotros.

*Informaciones sobre la Extracción del Radio.**

La planta para el tratamiento de los minerales radíferos establecida en Gif, cerca de París, pertenece a la "Societé francaise du Radium." Los minerales que allí se tratan provienen de la "South Terras Uranium Mine" en los Cornouailles; esta mina da minerales de uranio desde hace 26 años; constituye uno de los principales yacimientos de uranio que se conocen.

Antes de ser enviado a Francia, el mineral sufre in situ un tratamiento preliminar. La primera operación es el secado, que tiene lugar en una larga cámara rectangular, de palastro, dividida horizontalmente en dos compartimientos. Se deposita el mineral en una de las extremidades del tabique; luego rastrillos fijados sobre barras transversales accionadas por cadenas sin fin, hacen avanzar gradualmente el mineral sobre la mesa. El secado se hace por medio de una corriente de aire calentado a vapor y que circula en el compartimiento inferior, bajo la acción de un ventilador; el sentido de esta circulación, es opuesto al de la progresión del mineral. Este aparato puede tratar cerca de una tonelada por hora.

Después de haber sido secado, el mineral es triturado, luego pasado a un tamiz giratorio; la parte más fina está lista para ser enviada a Francia, mientras que las partes más gruesas son tratadas de nuevo en un triturador de bolas.

En la planta de Gif, el mineral radífero es sometido sucesivamente a las operaciones siguientes:

a) Es atacado por ácido, según un procedimiento mantenido en secreto y que reduce a algunas horas solamente, el tiempo necesario para poner en solución el radio;

b) La solución obtenida es decantada; luego tratada por sulfato de bario, que arrastra todo el radio. El líquido que queda es neutralizado por carbonato de calcio, luego precipitado por cal; la mezcla de líquido y de precipitado, es tratada en un filtro-prensa. El líquido proveniente de éste es botado, después de haber sufrido un tratamiento químico destinado a hacerlo inofensivo; en cuanto a las pastas, contienen óxido de uranio y substancias radio-activas (ionio, actinio, polonio), y sufren un tratamiento ulterior;

c) El sulfato de bario radífero, es transformado en carbonato de bario radífero. Esta operación se hace en un agitador de 8³ m. de capacidad, calentado por vapor y accionado por electricidad;

d) Los carbonatos de bario y de radio, son tratados por el ácido clorhídrico; después de la disolución, el líquido es precipitado por amoniaco, lo cual tiene por objeto proceder a un refinado previo;

e) El líquido y el precipitado son agrupados en un filtro-prensa;

f) El líquido es enviado a cubas de doble fondo, calentadas por vapor, en donde tiene lugar la evaporación, hasta la cristalización;

En cuanto a las pastas, son tratadas para los subproductos que contienen, al mismo tiempo que los obtenidos en (b);

g) Los líquidos sometidos a la cristalización fraccionada son llevados a una ley de radio determinado. Los productos obtenidos, consistentes en cloruro de bario radífero, son sometidos al "fraccionamiento medio"; los residuos que provienen de esta última operación, sirven para la precipitación de los sulfatos (operación b);

h) Los productos que resulten de (g), son concentrados por una segunda cristalización fraccionada.

i) En fin, los productos que provienen de (h), son enviados al laboratorio, en donde sufren un último fraccionamiento que da sales de radio puras, generalmente bajo la forma de:

$$Ra\ Br^2,\ 2\ H^2\ O,$$

de una concentración que puede alcanzar 98 por 100.

* Boletin de M. I. y Construcciones.

El Monóxido de Carbono.

De un artículo publicado en el "Engineering & Mining Journal," tomamos lo siguiente:

"Uno de los más serios peligros de la presencia del monóxido de carbono en el aire de las minas es su efecto sobre la salud de los trabajadores que se hallan expuestos a respirar diariamente pequeñas cantidades de este gas. La sangre, parcialmente saturada de ese gas, se vuelve inhábil para llevar al cabo sus funciones propias, de manera que el paciente sufre de anemia y de todas las complicaciones que puedan resultar de este debilitamiento. Según el Dr. Edsall, la enfermedad conocida con nombre tísis de las minas, es debida al envenenamiento con el monóxido de carbono."

Una pulgada cúbica de agua evaporada bajo la presión atmosférica ordinaria, se convierte, aproximadamente en un pie cúbico de vapor.

Multiplicando por dos el diámetro de un tubo, se aumenta cuatro veces su capacidad.

Acero Obtenido Directamente.

Refiere el ingeniero Humbert que estas experiencias fueron realizadas con un horno Heroult de 6 tw. a corriente monofásica y con carga: a) de magnetita siliciosa; b) de mineral al 30 por 100 de "riblous"; c) de mineral brasileano. El acero obtenido por tal medio es superior al obtenido por los medios usuales, teniendo propiedades especiales muy importantes. Se repetirán las experiencias con un nuevo tipo de horno, en el cual la carga se mantendrá baja para obtener una ebullición violenta. Los electrones serán de antracita. En conclusión, las ventajas que se obtendrían con tal procedimiento serán: a) una sola operación y un solo horno; b) facilidad de controlar la energía eléctrica; c) posibilidad de utilizar como material refractario la magnetita titanífera etc.; d) rápida fabricación, eliminación de impurezas y homogeneidad en el producto obtenido; e) costo inferior al del acero eléctrico producido con la fundición.

Los motores de agua necesitan aproximadamente de 20 a 60 libras de agua de alimentación y de 3 a 12 libras de carbón por hora por cada caballo de fuerza.

El Petróleo en México.

El petróleo mexicano compite en precio y calidad con el petróleo de los nuevos campos de Rivadavia, Argentina, no obstante que el costo de producción en esos campos es el $12.12 dólares por tonelada métrica de petróleo, que viene a ser casi el mismo costo del petróleo mexicano una vez fuera del puerto (pues hay que pagar derecho de barra, impuesto de timbre, etc.) Argentina gasta anualmente $21.000.000.00 de dólares, en importar combustible (carbón) para sus industrias. El poder calorífico del petróleo argentino varía entre 10,00 y 10,300 calorías, mientras que el mexicano oscila entre 10,100 y 10,300.

Se puede hacer también un magnífico cemento para tapar las rajaduras en las calderas de vapor así como para tapar toda clase de junturas por donde se verifiquen escapes de vapor, tomando dos partes de litargirio en polvo fino, una parte de arena muy fina y una parte de cal viva que se haya dejado apagar espontáneamente en un lugar húmedo. Hágase con todo eso una mezcla y guárdese en donde no le de el aire. Antes de usarse hágase una pasta con aceite hervido.

El Atacamiento de la Dinamita

Existen dos creencias erróneas respecto de la dinamita. Es una la de que dicho explosivo "estalla hacia abajo" y otra la de que no necesita ser atacada. Débese la primera al hecho de que la dinamita es mucho más poderosa que la pólvora de barrenos y por consiguiente, cuando se la usa en una roca, emplea parte de su fuerza en romper ésta.

Cuando la industria de explosivos daba sus primeros pasos y los fulminantes ordinarios y eléctricos no poseían la misma eficacia que hoy tienen, muchas personas preferían no atacar la dinamita con el objeto de que si una ceba fallaba, cosa muy frecuente en aquellos días, fuera posible poner otra.

Como la dinamita sin atacar ejecutaba exactamente el mismo trabajo que la pólvora atacada se creyó en aquel entonces que no era preciso efectuar tal operación tratándose de los explosivos violentos. La dinamita, cuando se la pone en un taladro emplea, aunque no se le ataque, gran parte de su fuerza en romper las paredes que la confinan, pero como el principal efecto de un explosivo se ejerce en el sentido de la línea más débil, es cosa evidente que en un barreno no atacado una parte muy considerable de la energía que posea la dinamita se escapará por allí.

Existen muchas razones que demuestran la conveniencia de atacar la carga aún en los casos en que se emplean explosivos poderosos. Tratándose de los que se usan en las minas gaseosas y de carbón, dicho atacamiento debe hacerse con materiales no combustibles, pues de otro modo es muy fácil dar margen a la ignición de los gases.

No es fácil probar matemáticamente que el atacamiento aumenta la eficacia de un explosivo, pero la experiencia así lo ha enseñado siempre. Podemos citar un ejemplo de ello. Hace algunos años cierta entidad que tenía a su cargo la apertura de dos túneles, el uno en la parte norte y el otro en la parte sur de una misma sección, pudo observar que en uno de ellos los gases nocivos producidos por la dinamita eran muy abundantes. La roca, en una y otra parte, tenía consistencia idéntica y los explosivos y fulminantes eran los mismos y sin embargo, el individuo que tenía a su cargo el túnel del Sur consumía seis cajas de dinamita diarias y efectuaba un avance de sólo 3 pies al día, en tanto que el encargado de la otra parte empleaba sólo tres cajas de explosivo y hacía un progreso de 6 pies diarios. Verificadas las investigaciones del caso se supo que este último empleaba el atacamiento con abundancia y que el otro desde que efectuó la primera voladura, había ido aumentando el explosivo y disminuyendo el atacamento, lo cual daba por consecuencia que los resultados del trabajo fuesen menores y la producción de gases dañinos aumentara.

Un atacamiento propiamente hecho y para el cual se empleen materiales adecuados, equivale, en un sentido, al uso de explosivos poderosos y al empleo de dos o más fulminantes eléctricos. Entre más se ataque un explosivo violente, más correctamente estallará, menos nocivos serán los gases producidos y más grande será la cantidad de trabajo ejecutada.

Este hecho ha tenido plena comprobación en las experiencias verificadas con explosivos nuevos los cuales, en todos los casos, estallaron correctamente cuando se les puso en el barreno y se les atacó como es debido y fallaron completamente cuando se dejó de cumplir tal requisito.

En las minas de carbón el mejor material que puede emplearse para el atacamiento es el barro o la arcilla refractaria que contenga un 10 por ciento de humedad más o menos, siempre que se trate de agujeros poco profundos, es decir, de aquellos en que la distancia entre la carga y la boca no exceda de un pie.

Para los barrenos profundos, lo más adecuado es la arena húmeda; sin embargo suele empleársela seca por ser más fácil de aplicar cuando se halla en tal forma. Una de las ventajas que ofrece la arena para estos fines es la propiedad que tiene de compactarse y adherirse a las paredes del barreno cuando los gases de la explosión actúan sobre ella. En ciertos casos, al efectuar voladuras en roca estratificada, se vió que aunque la arena se hallaba adherida a las capas superiores destrozadas por el explosivo, la más profunda estaba compacta de tal modo en los barrenos que no sólo no había sido volada por el explosivo sino que luego fué extraordinariamente difícil extraerla. Hace algunos años, en las canteras pertenecientes a una Compañía manufacturera de cemento se llevó a cabo la experiencia de atacar unos barrenos con arena y otros con cemento para establecer comparación entre el efecto de uno y otro. Dicha experiencia se verificó durante el verano y la carga se dejó de un día para otro con el objeto de que el cemento secase perfectamente. Al volar los barrenos se vió que no había diferencia ninguna entre los resultados producidos por los dos materiales. En ciertas canteras de piedra caliza se verificó, hace algún tiempo, otra experiencia semejante; la mitad de una serie de barrenos fueron atacados con arcilla húmeda y la otra mitad con arena. La voladura se presenció desde un punto adecuado y pudo observarse que toda la arcilla fué volada por la explosión en tanto que la arena permaneció firmemente en su sitio. Cuando se trata de abrir túneles en roca refractaria la importancia del atacamiento es enorme. Así lo han reconocido todos los expertos que de esta clase de trabajos se encargan y quienes suelen traer los materiales necesarios para tal operación desde grandes distancias.

En las canteras se acostumbraba anteriormente cargar los taladros que medían 8 pulgadas de profundidad poniendo dinamita hasta llenarlos por completo y colocando luego el fulminante en la superficie de aquella.

Como las personas que tenían propiedades en los alrededores se quejaran por el ruido que aquellas explosiones producían, se suprimió la mitad de dichas cargas y se las atacó con arena seca. Se pudo observar entonces que siguiendo tal método se efectuaba la misma cantidad de trabajo con sólo la mitad del explosivo empleado antes.

El atacamiento aumenta la eficacia de cualquier explosivo; entre más completo sea aquel, mayores serán los efectos de este último. Además, asegura una detonación perfecta y disminuye el peligro de las igniciones del gas y del polvo en las minas de carbón. La eficacia del atacamiento depende más del peso que alcance el material usado que de lo más o menos fuertemente que se le ajuste dentro del taladro. El cemento o el yeso no producen mejor efecto que la arena empleada en igual cantidad. Entre más débil sea el explosivo más atacamiento necesita, pero aún los explosivos más violentos producen mejor efecto cuando se les ataca debidamente.

Boletín Sobre los Hornos.

En conección con las investigaciones llevadas a cabo por orden del gobierno de los Estados Unidos de América con el objeto de evitar el desperdicio y aumentar la seguridad y eficiencia en la industria minera, el Bureau de Minas segunda parte, escrita por los Sres. R. del país antes citado, ha emprendido un estudio sobre las posibilidades del empleo de los hornos eléctricos en la metalurgia.

Los resultados de esas investigaciones están contenidos en un Boletín que recientemente ha editado el citado Bureau, cuyo Boletín contiene una excelente información sobre la materia, inclusive la construcción y operación de los hornos eléctricos.

El Boletín a que se hace referencia consta de 216 páginas de 6 por 9 pulgadas y está dividido en tres partes, la primera de las cuales está escrita por los Sres Dorsey A. Lyon y J. F. Cullen y se refiere al diseño, construcción y operación de los hornos eléctricos. La M. Keeney y Dorsey A. Lyon se refiere a la fundición de metales en los ya citados hornos y la tercera parte escrita por R. M. Keeney abarca los detalles de la manufactura de las aleaciones de hierro en el repetido horno eléctrico.

Las siguentes conclusiones son tomadas del referido Boletín y se refieren al papel que puede desempeñar el horno eléctrico. "En el horno de combustión no importa cual sea el combustible que se use, la temperatura no puede exceder de 2,000 grados centígrados. En el horno de combustión la eficiencia varía de 2 a 60 por ciento mientras que en el horno eléctrico el promedio de eficiencia es de 60 por ciento. En el horno de combustión no solamente es necesario tener cuidado con los productos de la combustión sino que esos productos pueden reducir la eficiencia del procedimiento mientras que el horno eléctrico está exento de esas dificultades. En el horno eléctrico la temperatura obtenible siempre es la misma ya sea que el horno se trabaje en escala comercial o en el laboratorio. En el horno eléctrico el calor puede ser desarrollado hasta cualquier grado que se desee y con el sólo hecho de pasar la corriente a través de las substancias que se vayan a tratar el calor necesario para la operación puede ser desarrollado en la misma substancia. La temperatura de un horno eléctrico está completamente bajo un controll absoluto, y cualquier atmósfera deseada, ya sea neutral, oxidante o reductora puede obtenerse con facilidad relativa y con precisión absoluta. Estas ventajas juntamente con el hecho de que el producto generalmente es más puro que el del horno de combustión es un gran factor en favor del horno eléctrico.

En general puede decirse que es indispensable usar un horno eléctrico en todas las operaciones que requieran un calor superior a 2,000 grados Centígrado, pero las condiciones locales, así como la naturaleza del trabajo que se trata de hacer pueden alterar éstas, escogiéndose o el horno eléctrico o el de combustión según sea el caso. El costo de la fuerza también influye grandemente, pero aún siendo éste muy alto el costo de la fuerza eléctrica, la superioridad de la eficiencia del horno eléctrico, la posibilidad de obtener un producto más puro y quizá una seguridad mayor para los operarios, son ventajas que si bien una sola de ellas no es suficiente para establecer la predilección del horno eléctrico sobre los de combustion, el conjunto de las importantes ventajas antes enumeradas si son dignas de tomarse en consideración al adoptar un horno de este género.

Nuevo Método para la Dosificación del Azufre en el Carbón y Coke.

Este método, empleado en el Laboratorio de las fábricas de acero de Makeevka (Rusia), está basado sobre el hecho de que los compuestos sulfurados orgánicos, lo mismo que los sulfuros y sulfatos minerales, calentados al rojo en presencia de un exceso de limalla de hierro, ceden su azufre al hierro para formar sulfuro de hierro y sulfuros inferiores que, tratados por un ácido, ceden la totalidad de su azufre al estado de H_2S.

En la práctica, se pesa 1 gr. de carbón, que se mezcla íntimamente, en un crisol de pasta (?) con 5 gr. de limalla de Fe; se cubre la mezcla con una ligera capa de limalla de Fe, a fin de recoger las trazas de sulfuros que podrían escapar a la reacción.

El crisol, provisto de su tapa, se introduce en otro crisol más grande (sistema de doble crisol empleado para la determinación de las materias volátiles en los carbones). El espacio libre, entre las dos tapas, se llena de carbón de madera en menudos pedazos, y el todo se pone, durante una hora, en una mufla calentada al rojo.

Después de que se enfríe, se retira el residuo de cok formado, se le tritura en un mortero, y se ponen los pedazos obtenidos en una redomita de ataque idéntica a las que sirven para la dosificación del azufre en los aceros y hierros de fundición. El H2 5, puesto en libertad por el ataque del ácido clorhídrico concentrado, se recibe en una solución de acetato de Zu.

Se titula el Zu S formado, como en la dosificación del S en los aceros y hierros de fundición, por medio de los licores de yodo y de hiposulfito, cuya relación se conoce. Se establece el título del hiposulfito haciendo una operación sobre un carbón o un coke cuyo tenor de S ha sido determinado por granimetría.

Este método permite a un solo operador hacer, en un día, cuarenta ensayes de dosificación.

En un laboratorio de metalurgia, se puede dividir el trabajo en dos fases:

1º Las pesadas, mezclas y calcinaciones, hechas por el manipulador encargado de determinar las materias volátiles en los carbones, y

2º Los ataques por HCl, y la titulación del Zu S, que se confían al manipulador que determina el azufre en los metales.

Sobre todas las cosas enséñeseles a conservar el molino siempre limpio, pues el encargado que recibe el próximo turno y se le entrega las chumaceras y en general toda la maquinaria debidamente lubricada, los pisos barridos y secos, está obligado a ldevolver su departamento al que lo entregó en las mismas condiciones en que lo recibió y en caso contrario el primero tendrá derecho a protestar.

Si se tiene planta de cianuración enséñeseles a que no deben tratar de filtrar a través de una capa de carbonato de cal de un octavo de pulgada.

Enséñeseles a que manejen los estanpues, muestras soluciones con reloj; y a tapar los escapes o filtraciones de los tanques y lavaderos evitando sobre todo las pérdidas de la solución, porque estas pérdidas significan dinero.

No se desatienda la parte científica de la molienda y de las otras ramas de la metalurgia sino que de lo contrario, déseles todo el tiempo posible. Subscríbase a los principales periódicos de minería y trátese de que sean leídos por todos aquellos operarios y empleados conectados con la negociación.

La hidrometalurgia está haciendo grandes progresos y a no dudarlo, marcará una nueva era en el beneficio de minerales de oro y plata en aquellos campos en que antes no era productiva su explotación.

Informes de Utilidad Práctica.

Una pulgada cúbica de agua, evaporada bajo la presión atmósferica ordinaria, quedará convertida en un pie cúbico de vapor (aproximadamente) ejerciendo una fuerza mecánica capaz de levantar 2,120 libras a un pie de altura.

Cada caballo de fuerza nominal de las calderas, requiere un pie cúbico por hora de agua de alimentación.

Las buenas calderas, montadas y con un buen cuidado en la cámara de fuego, buena corriente de aire, evapora de 7 a 10 libras de agua por cada libra de carbón mineral de buena clase. El promedio resulta generalmente menor que esta cantidad.

Un pie cuadrado de superficie del emparrillado, bajo una corriente natural de aire, consumirá por término medio de 10 a 12 libras de carbón o hulla arenosa o 18 a 20 libras de carbón o hulla blanca, o 22 a 28 de leña seca por hora.

Bajo una corriente de aire o tiro forzado estos promedios pueden casi duplicarse.

Para calcular los caballos de fuerza de una caldera, considérese las tubulares en 15 pies cuadrados, las de flux en 12, las de cilindro en 10 pies cuadrados de superficie de caldeo, como equivalentes a un caballo nominal de fuerza.

El talón o medida por la cual se rige para calcular la fuerza de una caldera,

según el sistema de la Sociedad Americana de Ingenieros Mecánicos, es como a continuación se expresa: Un caballo de fuerza es igual a 30 libras de agua, convertida por medio de la evaporación en vapor seco por hora de agua de alimentación a una temperatura de 100 grados Fahrenheit, y bajo una presión de 70 libras por pulgada cuadrada sobre la atmósfera.

La máquina de vapor con condensación sencilla desarrollará un caballo de fuerza con 18 a 22 libras de agua.

Una máquina de vapor automática con escape libre desarrollará un caballo de fuerza con 28 a 32 libras de agua

Un caballo de fuerza es aquella fuerza capaz de levantar 33,000 libras a un pie de altura en un minuto.

El gasto o consumo de combustible tiene un promedio de 7½ libras de carbón o hulla o sean de 15 de madera de pino seca por pie cúbico de agua evaporada.

Un galón de agua dulce (galón de los Estados Unidos del Norte) pesa 8 1/3 libras, conteniendo 231 pulgadas cúbicas.

Un pie cúbico de agua contiene 7½ galones, o sean 1,728 pulgadas cúbicas, pesando 62½ libras.

La altura de una columna de agua dulce, igual a una presión de una libra por pulgada cuadrada es 2.31 pies.

Una columna de agua de un pie de altura, ejerce una presión de 0.434 libras por pulgada cuadrada.

Duplicando el diámetro de un tubo se aumenta su capacidad cuatro veces. La fricción de los líquidos en los tubos aumenta en la misma proporción que el cuadrado de la velocidad.

La presión media de la atmósfera se calcula generalmente a razón de 14.7 libras por pulgada cuadrada, de modo que con un vacío perfecto sostendrá una columna de mercurio a 29.9 pulgadas. o una de agua 33.9 pies altura.

El peso específico de un cuerpo es la proporción que el peso del cuerpo sostiene con el de otro cuerpo de igual volumen.

Los caballos de fuerza necesarios para elevar agua a una altura dada se obtienen multiplicando el peso del agua elevada por minuto en libras por altura en pies, dividiendo el producto por 33,000. Se debe rebajar además un 25 por ciento a causa de la fricción del agua, etc.

Una libra de petróleo crudo evapora 15 libras de agua.

El consumo de zinc en las cajas de precipitación varía de ¼ a ½ libra por cada tonelada de mineral tratado.

Un pie cúbico de agua contiene 7.48 galones americanos y pesa 62.5 libras. Un galón americano de agua pesa 8.34 libras.

Puede calcularse con seguridad que 2¼ libras de leña seca equivalen a una libra de carbón suave de calidad media.

Tabla Internacional de Pesos Atómicos.

1915.

Aluminio	Al	27.1	Mercurio	Hg	200.6
Antimonio	Sb	120.2	Molybdeno	Mo	96.0
Argon	A	39.88	Neodimio	Nd	144.3
Arsénico	As	74.96	Neon	Ne	20.2
Azufre	S	32.07	Níckel	Ni	58.68
Bario	Ba	137.37	Niton (emanación del radio)	Nt	222.4
Bismuto	Bi	208.0	Nitrógeno	N	14.01
Boro	B	11.0	Oro	Au	197.2
Bromo	Br	79.92	Osmion	Os	190.9
Cadmio	Cd	112.40	Oxígeno	O	16.00
Caesio	Cs	132.81	Paladio	Pd	106.7
Calcio	Ca	40.07	Plata	Ag	107.88
Carbono	C	12.00	Platino	Pt	195.2
Cerio	Ce	140.25	Plomo	Pb	207.10
Cloro	Cl	35.46	Potasio	K	39.10
Cromio	Cr	52.0	Prasieodimio	Pr	140.6
Cobalto	Co	58.97	Radio	Ra	226.4
Columbio	Cb	93.5	Rodio	Rh	102.9
Cobre	Cu	63.57	Rubidio	Rb	85.45
Disprosio	Dy	162.5	Rutenio	Ru	101.7
Erbion	Er	167.7	Samario	Sa	150.4
Estaño	Sn	119.0	Scandio	Sc	44.1
Europio	Eu	152.0	Selenio	Se	79.2
Flour	F	19.0	Silicon	Si	28.3
Fósforo	P	31.04	Sodio	Na	23.00
Gadolinio	Gd	157.3	Stroncio	Sr	87.63
Galio	Ga	69.9	Talio	Tl	204.0
Germanio	Ge	72.5	Tantalo	Ta	181.5
Glucinio	Gl	9.1	Telurio	Te	127.5
Helio	He	3.99	Terbio	Tb	159.2
Holmio	Ho	163.5	Titanio	Ti	48.1
Hidrógeno	H	1.003	Torio	Th	232.4
Hierro	Fe	55.84	Tulio	Tm	168.5
Indio	In	114.8	Tungsteno	W	184.0
Iridio	Ir	193.1	Uranio	U	238.5
Krypton	Kr	82.92	Vanadio	V	51.0
Lanthano	La	139.0	Xenon	Xe	130.2
Lithio	Li	6.94	Yodo	I	126.92
Lutecio	Lu	174.0	Yterbio (Neoytterbium)	Yb	172.0
Magnesio	Mg	24.32	Ytrion	Yt	89.0
Mànganeso	Mn	54.93	Zinc	Zn	65.37
			Zirconio	Zr	90.6

Grasa Lubricante, Procedimiento Dalannay.

Esta grasa está compuesta de: 100 partes de grasa mineral común, del tipo aceite para cilindros y 120 partes de grafito. El mejor grafito es el "perfecto fabricador Dixon," que es sumamente suave. La mezcla se hace por amasado a una temperatura de 60—70 grados C.

Esta grasa se emplea para mantener la suavidad y el estancamiento de las llaves de agua, vapor, gas, etc.; para suavizar el frotamiento y prevenir el calentamiento de los ejes, correderas, etc., para preservar los aparatos diversos de la oxidación desleída a los vapores ácidos o amoniacales. Hace el desmonte fácil aunque la pieza esté en un sitio húmedo.

Las proporciones indicadas pueden variar según las necesidadas y según la temperatura. La cantidad de grafito debe ser más grande en los países calientes que en lo spaíses fríos.

Los pisones (de molinos) no deben trabajar a más de 110 golpes por minuto, y para obtener esta velocidad hay que emplear unos dientes cortos (los brazos curvos que adheridos al eje sirven para levantar los pisones) y un golpe no mayor de 5 pulgadas.

El Hierro Vanadium.

Para los neofitos en estas materias, el hierro es simplemente hierro y todas las clases de él son exactamente iguales, pero el mecánico hábil conoce bien la diferencia que existe entre una y otra y sabe que cada cual es propia para un trabajo determinado. Cierto hierro, duro y quebradizo, por ejemplo, es adecuado para ejecutar trabajos que no pueden ser hechos con hierro blando; el muy maleable, tan útil en ciertos casos, no sirve en otros. El hierro ideal sería, por consiguiente, el que se prestase para todos los usos satisfaciendo plenamente las exigencias particulares de cada trabajo en que se le empleara; un hierro de tales condiciones sería tan apreciado como el oro mismo por manufactureros y consumidores.

Los experimentos y estudios llevados a término en busca de este hierro ideal han conducido al descubrimiento de diferentes clases, cada una de las cuales es útil para un fin determinado; ninguna de ellas, sin embargo, ha podido alcanzar fama idéntica a la conseguida por el "Hierro Vanadium," el cual, como su nombre lo indica, contiene grandes cantidades de vanadio, componente que le da un grado de resistencia no imaginado antes. Dicho hierro es especialmente útil para fundiciones pequeñas que exigen gran fortaleza, y se le emplea, de modo muy amplio, en la manufactura de cilindros para automóvil y para máquinas de vapor, para compresores de aire, herramientas neumáticas, etc., porque resiste perfectamente presiones enormes y porque puede dársele un pulimento imposible de obtener con el hierro ordinario. No tiene igual para la fabricación de bañaderas, calefactores de vapor y otros varios productos en cuya elaboración se requiere un material que tenga gran resistencia y que a la vez sea suficientemente blando para permitir la ejecución del acabado en máquina. Este hierro tiene un grano fino y compacto; su fuerza es verdaderamente fenomenal, según lo han demostrado los rígidos experimentos a que se le sometiera; durante las pruebas verificadas por el conocido profesor Edwin T. Fitch, del Lafayette College, este hierro mostró poseer una fuerza ténsil de 26,620 libras por pulgada cuadrada.

Lo más económico en una fundición de categoría, es emplear siempre los mejores materiales; se ahorran así las pérdidas que suponen las fundiciones cuyos defectos aparecen después de ejecutadas o aquellas que no muestran las deficiencias de que adolecen sino después de que se las ha puesto en uso. Con el "Hierro Vanadium" se obtienen fundiciones verdaderamente perfectas lo cual significa ahorro de dinero para el fabricante y para el consumidor.

Al calcular la fuerza en caballos de las calderas tubulares, considérense quince pies cuadrados de superficie de calefacción como equivalente a cada caballo de fuerza.

Producción de Petróleo en los Diferentes Países.

Dado el aumento considerable de las aplicaciones del petróleo, su importancia para nuestro país en vías de adoptar en gran escala su explotación, creemos conveniente publicar la producción de petróleo en los diversos países petrolíferos.

Estados Unidos	32	29,5
Rusia	9	9,5
México	2	2,3
Rumania	1,8	1,8
Indias inglesas y neerlandesas	1,7	1,7
Austria	1	1,7

Como se ve, Estados Unidos produce la mayor cantidad, cuya industria va en continuo desarrollo, siendo California y luego Oklahoma los estados más ricos, pues los dos solos, proveen los 2/3 del total de la producción del país.

Ventajas del Empleo del Combustible Líquido en las Calderas.

Trataremos de exponer suscintamente las ventajas que en general se obtienen con el empleo del combustible líquido, siguiendo principalmente para nuestra exposición las opiniones que al respecto vierten los autores Colomer y Lordier en su obra "Combustibles industriels," en la que, tratando en general todos los combustibles de aplicación industrial, hemos de encontrar juicios imparciales, sin las exageraciones en pro del empleo del pertóleo, en que lógicamenten puedan incurrir los tratadistas que especialmente se ocupen de este producto.

Ante todo, para poder utilizar el combustible líquido en una caldera común se requiere una preparación de la misma, sumamente sencilla y fácil de realizar, que consiste, además de la instalación del quemador especial, de los que los hay de innumerables tipos y sistemas, en retirar los barrotes de las parrilas del hogar y revestir a este último con una capa de ladrillos refractarios. Aun en ciertos casos, cuando no se tiene la seguridad de poder disponer del combustible líquido con regularidad, por ejemplo, se puede preparar el hogar de las calderas de modo que se preste a consumir petróleo o carbón indistintamente; bastará intalar el quemador con un brazo articulado que permita retirarlo hacia el exterior de la caldera y no sacar la parrilla, limitándose a colocar sobre ella una capa de ladrillos refractarios y a revestir con estos últimos la bóveda del hogar.

Para quemar carbón sólo es necesario, entonces, retirar la capa refractaria colocada sobre la parrilla y hacer girar el quemador hacia afuera. Se ve, pues, que la implantación de un quemador en una caldera es una operación sumamente fácil que puede realizarse, por otra parte, en muy poco tiempo casi sin interrumpir la producción de vapor y con un costo reducido.

Hemos indicado que, según los ensayos de los ingenieros Moreno, Mermoz y Taina, con una tonelada del combustible líquido se puede evaporar 50 por 100 más de agua que con la misma cantidad de carbón. El precio de venta del petróleo, si bien hoy es de $24.00 la tonelada, término medio, ha de poder reducirse indiscutiblemente en mucho; pero fijemos, para hacer comparaciones en contra del petróleo, el precio de $20.00 la tonelada, que será sumamente excesivo cuando pueda darse el impulso requerido a la explotación de los yacimientos. Con los $20.00 de petróleo se obtiene aproximadamente un rendimiento de vapor de 12.210 kg.

A esta ventaja hay que agregar que el petróleo no deja cenizas; que su introducción en el hogar se hace automáticamente. Además, la combustión con la hulla no da nunca una temperatura constante, a causa de los cambios de espesor del combustible sobre la parrilla y de las entradas de aire en el hogar, inevitables al abrir las puertas para la provisión de combustible; con el petróleo, en cambio, se obtiene una temperatura constante y muy superior. Una última ventaja es el poco personal que se requiere para la vigilancia de los hogares, pues un solo hombre basta para una batería de ocho a diez calderas.

Para las locomotoras, las ventajas del empleo del combustible líquido son aún mayores, a saber:

1º El trabajo difícil y fatigoso del fogonero se hace mucho más cómodo, gracias a la alimentación continua y automática de los hogares, que suprime igualmente las entradas de aire por las puertas.

2º Con mucha rapidez se prenden los fuegos y se llevan a presión las calderas. En depósito, con agua fría y tomando vapor de una locomotora vecina o de una caldera fija para hacer funcionar el inyector, se requiere media hora para llevar el agua a 100° y una hora y media para obtener una presión de 12 kg.; con agua de alimentación a 70°, se llega a 9 kg. de presión en menos de una hora.

3º La combustión carece de humo; se evita la producción de este último reduciendo la llegada de petróleo cuando se ve la presencia de un penacho de humo en la chimenea.

4º Se puede hacer variar fácil y rápidamente la presión en la caldera y se obtiene una presión perfecta en la regulación del fuego. Dada la alimentación automática, se puede aumentar o parar instantáneamente la producción de la caldera.

5º Hay ausencia de polvo y de hollín en los tubos y en la caja de humo.

6º Se requiere menor gasto de conservación para el hogar y los tubos, debido al pequeño contenido de azufre del petróleo. Gracias a la presencia del re-

timiento, las calderas se enfrían lenta y uniformemente, lo que es a la vez económico y favorable a su conservación.

7º Dados el mayor poder calorífico del combustible líquido y la facilidad para activar el fuego instantáneamente, se pueden franquear distancias mucho más considerables con una provisión dada de combustible.

Otra ventaja es la facilidad con que las máquinas se aprovisionan de combustible, pues esta operación se puede realizar, en efecto, en dos o tres minutos.

Estas ventajas se acentúan aún más con el empleo del petróleo en la marina. Ya hemos indicado que sometiendo el combustible líquido a un principio de destilación, se obtiene un producto de un punto de inflamación relativamente elevado y apto para ser utilizado sin peligro en la marina.

El petróleo, así preparado, se almacena en depósitos situados bajo la línea de flotación de las embarcaciones, de modo que se haga sentir lo menos posible la acción de la temperatura ambiente; en él puede introducirse una barra de hierro calentada al rojo, sin peligro de inflamación.

Aun bajo el punto de vista de la marina de guerra, el petórleo convenientemente preparado por la destilación, ofrece la mayor seguridad. Tweddle ha hecho experiencias en las que los obuses y shrapnells arrojados sobre recipientes llenos de dicho combustible, no han producido más efecto que el de perforar los envases, sin inflamar el líquido. Todavía más: se ha hecha estallar dentro del petróleo, así preparado, cartuchos de pólvora y dinamita, obteniéndose simples poyecciones del líquido sin inflamación.

Se consigue, pues, en la forma indicada, un combustible sin peligro alguno, en el que los riesgos son menores aun que con el carbón, cuya combustión espontánea es motivo muy frecuente de incendios.

Otra de las grandes ventajas del empleo del petróleo para quemar en las embarcaciones, consiste en la facilidad que ofrece la carga de este combustible, la cual puede hacerse aún en plena mar, sin atracar a muelles, con toda la comodidad y rapidez con que se efectúa la provisión de agua dulce de los barcos en las radas.

En cuanto a las instalaciones terrestres para almacenar el combustible y transportarlo a las embarcaciones, que se reducen a simples tanques, de los que se envía el líquido al muelle mediante bombas, son mucho más económicas que los complicados silos y transporte que exige el carbón para obtener una carga relativamente rápida y a buen precio.

Además, "quemando carbón, el hollín y las cenizas que arrojan las chimeneas, ensucian mucho la embarcación; es necesario destinar un tiempo apreciable para la limpieza y pintura de los puentes y partes superiores, mientras que un navío que emplea petróleo puede mantenerse limpio muy fácilmente. La supresión del humo tiene, entre otras ventajas, la de permitir a los torpederos y demás barcos de guerra moverse de día o de noche sin llamar la atención del enemigo por un penacho de llama o de humo.

La temperatura de la sala de calderas es inferior a la que se desarrolla cuando se emplea carbón, porque no es necesario abrir las puertas de los hogares y tampoco hay cenizas que extraer. El trabajo del fogonero se facilita, pues, en una proporción notable.

Además, hemos visto que una tonelada de petróleo aproximadamente por término medio, tiene un poder de evaporación un 50 por 100 mayor que el carbón Cardiff; por otra parte, en un metro cúbico de bodega se puede almacenar 920 kg. término medio de petróleo, que equivalen por lo tanto a 920 kg.×1,50=1.380 kg. de carbón.

A su vez en un metro cúbico se puede almacenar aproximadamente 870 kg. de carbon; es decir, 510 kg. menos que su equivalente en petróleo.

Si se tiene en cuenta, además, la dificultad de arrimar los gruesos trozos de hulla y la facilidad de emplear los dobles fondos y espacios perdidos para almacenar el petróleo, se verá que con la utilización del combustible líquido se consigue una economía de espacio que llega próximamente a un 50 por 100, o a igualdad de espacio, se puede almacenar una cantidad de combustible capaz de evaporar doble cantidad de agua, es decir, se duplica el radio de acción del navío.

Finalmente, a medida que va utilizándose el ptróleo para el consumo de la embarcación, se pueden llenar de agua los compartimentos correspondientes con lo que, dada la proximidad de los pesos específicos de los dos líquidos, no se altera el equilibrio del barco; con el mismo fin se puede sin mayor dificultad, hacer pasar el petróleo de un compartimento a otro. No sucede lo mismo con el carbón, que exige muchas precauciones para tomar las cantidades necesarias al consumo en sitios adecuados, de modo de no descargar desigualmente la embarcación, originando a menudo costosos transportes del combustible de un punto a otro para poder mantener equilibrando el lastre.

Para encontrar la presión en libras por pulgada cuadrada de una columna de agua, multiplíquese la altura de la columna en pies por 434. Se dice que, aproximadamente, cada pie de elevación es igual a media libra de presión por pulgada cuadrada, estando comprendida la fricción ordinaria.

Las calderas bien diseñadas, debidamente instaladas y cuidadosamente encendidas, evaporan de 7 a 10 libras de agua par cada libra de carbón. El término medio es de 25 a 60 por ciento menos.

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The Metal Markets.

Judging from the course of the metal markets, mining for the chief industrial metals is entering upon a period of healthy prosperity. The period of feverish demand and speculative prices has passed, and orders now are no longer based on immediate delivery, but often involve contracts running into many months. Except in the case of spelter, prices are no longer extraordinary, but such as to yield a good profit on operations enjoying reasonable advantages. Copper at eighteen cents a pound should yield a good return even in war time, and when costs are somewhat above the normal.

The greatest volume of demand for copper, zinc and lead is still from European countries, but consumers in the United States are taking good tonnages of all the metals, and especially of copper. The ammunition makers are still taking large quantities of the metals but their requirements do not constitute the whole demand.

Among the metals in great demand and which Mexico could supply is antimony, which during the last week in October brought in New York from 35 to 46 cents per pound. The only reason why Mexican producers are not reaping a rich harvest is because transportation in the country is still unable to handle the freight offered.

The lack of transportation facilities is the only thing that prevents a prompt revival of mining throughout the country.

Changes in the Potash and Nitrate Industries.

The great war is bound to bring changes in many of the industries, but in none is it likely to have a more profound effect than in that concerned with the supply of potash and nitrates largely used in agriculture. For many years the bulk of the nitrates used to fertilize the fields has been derived from the beds of Chile, where a vast industry has been built on the demand from this source. For some years small amounts of synthetic nitrates have been reaching the markets, but it required the great war with its dislocation of communications to stimulate production on a really large scale. There is reason to believe that Germany now produces synthetically all the nitrates it needs for the manufactures of the enormous quantites of explosives expended at the various fronts. After hostilities cease it is not likely that the Chilean beds will again be the world's only source of nitrates for all purposes.

Germany has for many years furnished the bulk of the soluble potash salts used in agriculture. Its enormous deposits and thoroughly organized development prevented serious competition from new and untried sources. Now that export from the central empires has practically ceased, schemes for producing potash in other ways are receiving attention. The rocks of this continent contain potassium compounds in abun-

dance. The trouble is to convert it to a soluble form at a sufficiently low cost. Feldspar may be made to yield its potassium but the process is complicated and expensive and not to be lightly undertaken on a modest scale, although promising results have been obtained in that direction. The first practical plan to be put in operation concerns the beds of alunite, a mineral which is fairly abundant in the Western United States and Mexico. During the past month a plant for the extraction of potassium sulphate from alunite has begum operations in Utah. The process employed is very simple. The mineral is simply roasted to convert the potassium into a soluble sulphate. This is then leached and the potash recoverd by evaporation. Alumina remains in a pure form and constitutes a valuable by-product. The new plant will produce from 25 to 30 tons of potassium sulphate, running over 90 per cent, daily. The product is said to be of somewhat higher grade than that marketed by the Germans. If it proves successful this industry is likely to expand until no more potash need be imported.

One result of the war is likely to be that henceforth America will produce its own potash and Europe its own nitrates.

Crude Oil Shipments from Mexico.

Shipments of crude oil form Mexican ports were heavier in August of this year than for any month since January, 1914. During August, 1,281,593 barrels were shipped to American ports and 70,444 barrels to the Canal zone, making a total of 1,352,037 barrels. During the same month of 1914 barely half of the given amount of oil was shipped to the United States.

Although the quantity of crude oil here mentioned appears to be large, the oil-fields of Mexico could easily ship four times as much if transportation and market conditions were more favorable. The petroleum possibilities of the country have been as yet only faintly indicated. Not only could shipments from existing wells be increased fourfold but vast fields have not yet been touched by a drill, and none of the producing wells has yet shown any signs of exhaustion.

Coinage of Iron and Zinc.

The value of a coin now rarely depends upon its intrinsic metal content. Silver pieces are merely tokens of credit, and even gold coins are more useful as a medium of exchange than as a standard of value. There is, therefor, nothing revolutionary in the reports that fractional currency of zinc and iron is now circulating in Germany and Belgium. Iron or zinc pieces serve quite as well as those of copper and nickel while their usual constituent metals are more urgently needed for other purposes. Certainly iron coinage would be more satisfactory than the cartones which have done duty as small change in this part of the world during the past few months.

Action of Dissolvel Air in Mill Pulp.

Upon another page of the present issue we print some rather unusual views on the action of air dissolved in mill solutions upon the behavior of pulps in cyaniding and in flotation. Whether we agree with the author or not, a careful consideration of the questions here presented can not fail to be helpful, especially in Mexico, where air, or oxygen as the panacea for all mill extraction troubles, has been rather over-advertised. The author shows that, instead of being difficult to secure a thorough aeration of solutions, it would be almost impossible to prevent it in the ordinary mill. The flow of a liquid from an ordinary wide launder into a tank, breaking the stream, as it does, into thin films and fine jets, furnishes almost ideal condition for saturation with air. It requires no patent device and no costly chemicals to introduce sufficient oxygen into solutions when launders empty into tanks at dozens of points with thin films of liquid falling through the open air and carrying down with them bubbles and surface films of air under the most favorable conditions for solution.

The old Elsner equation, showing apparently that solution of gold in cyanide could not take place without the intervention of oxygen, has given rise to a line of thought that has not been altogeter beneficial to the art of cyaniding. That famous equation is still awaiting definite proof, by the way. If oxygen is necessary for the solution of gold it is only a step to the conclusion that it is also necessary for the solution of silver, for the quantity of this cheaper metal to be dissolved is greater and it is frequently present as a compound which must be broken up. We now know that a tank of clear solution usually contains a plentiful supply of oxygen, but a dissolved gas is not visible. Consequently we ought not to blame cyanide men for following after all sorts of aeration devices and oxidation chemicals.

The suggestion in the article in question that the involuntary over-aeration of solutions may cause obscure troubles in the cyanide mill raises a number of disquieting thoughts. The author suggest that an excess of oxygen may, besides destroying unnecessary percentages of cyanide by the oxidation of minerals, interfere with the free settlement of slimes. Most cyanide mills in this country were built under the old doctrine of super-aeration, and the usual remedy for non-settlement of slimes has been lime and still more lime. Economy in the use of lime has never been a strong point in Mexican cyanide practice. The river carrying the tail-waters down the valley from the mills in Pachuca contains a pound of unneutralized lime for every three tons of liquid, and this lime must be neutralized with acid before the water is fit for use in the lixiviation mill situated upon the river bank.

What if someone were to prove that in Pachuca a part of the cost of pumping air into solutions merely goes to increase the total outlay for lime?

Why Do Minerals Float?

In the early days of flotation there were many elaborate theories concerning the chemico-physical principles which caused particles of minerals, heavier than water, to float, and each theory led to a new patent. Since the development of frothing it is generally assumed that all mystery surrounding the process has been swept away, and that the principles involved ar-

simplicity itself. But it appears that flotation by creating a mass of bubbles and causing the particles of mineral to be entangled with the mass is not so simple as it might be.

The operation of introducing bubbles by means of violent agitation or by injecting air seems purely mechanical and simple, but it is now asserted that air or gas mechanically introduced does not form the kind of bubbles required. The bubbles must come from within the mixture, either from the air previously in solution in the liquids or solids, or from gas generated in contact with the minerals to be floated. One of the earlier and more successful patented processes depends upon the evolution of carbonic acid gas in the mixture. Experiments with submerged agitation seem to show that frothing is not due to the outside air, for agitation under pressure, not in contact with undissolved air, gives quite as good results as the methods in which air is whirled down from the surface or introduced through jets in the bottom.

Several recent attempts to explain flotation are interesting, even though they do not promise immediate practical returns. One calls upon a series of inter-acting tensions for reasons, not the comparatively simple surface tension of water, but forces much more intricate. It seems that in a flotation mixture there are states of tension between the surfaces of oil particles and the water and also between the solid surface of the mineral and the oil and water surfaces. The interaction of these forces causes the association of oil with mineral and the combination with the bubble. It is not safe to think of the oil, the gas and the mineral as sticking together like an envelope and a stamp. The entire phenomenon may be due to a set of repulsions instead of attractions.

Another interesting explanation is electrical in character. It seems that the surface film of a liquid, whether in contact with a gas, another liquid, or a solid, has different potential than that of the interior of the liquid. These forces are necessarily minute, but when applied to extremely small masses and over infinitesimal distances, they may not be inconsiderable. The interaction of these forces has been used to account for the curious attractions and repulsions which make flotation possible. Needless to say that these forces are static and do not involve amperage and current density, and that it will not be necessary to get out a patent covering electric flotation.

These are questions for the physical chemist, and need not worry the brain-cells of the millman for the present. Flotation is not the first process to give excellent practical results without being in the least understood. In the meantime the millman should be thankful to the gentlemen who are willing to investigate these high-brow affairs. It is never good economy to work in the dark.

Optimism under Difficulties.

"Compressed Air Magazine," October, 1915, finds hope for Mexico in the attitude of the Mexican Mining Journal towards the course of events, an attitude which it describes as one of "virile optimism." The magazine published in Easton, Pa., uses some exceedingly kind words in its appreciation of the Mexican Mining Journal. It says:—

"We are pleased to note that there has been no demoralization of the editorial department, or in fact any department, of the publication referred to, and that the issues now before us are certainly as good as any we have ever received, or in fact better. The editorial in the August issue, which we reproduce"—the article on Mexico's Wonderful Vitality—"is overflowing with virile optimism."

The Mexican Mining Journal has not invariably been commended for its optimism during the trying months now past. The position of an optimist is never an easy one. He preserves a cheerful demeanor under difficult circumstances, and if he has no basis for his cheerfulness, he is justly regarded as a plain fool. This sort of optimist is portrayed in a recent issue of Life. There was a picture of a small dog, cheerfully backing up against a log upon which the extremity of his person was to suffer amputation by means of a sharp ax, the pup remarking "Oh, well, I shan't lose much."

The Mexican Mining Journal has lost no part of its person, and has had throughout what it considers a good basis for its optimism, none other than the conviction that a great and glorious country like Mexico can not continue to disappoint its friends indefinitely. Back of that optimism are the enormous undeveloped resources of the country, its geographical position, its climate, the best in the world, not only for comfort but also for continuous effort, and the conviction that Mexico is destined to be the leading mining country in the world.

The kind remarks of the Compressed Air Magazine are especially welcome, for while the struggle against discouraging conditions was unremitting, The Mexican Mining Journal could not always convince itself that it was doing its full duty by its readers. Many of the distinctive features had to be postponed, for one, the news of the Mexican camps, the very foundation stone of the Journal's existence. There were occasions when the whole truth could not be told and when our friends had a right to expect the whole truth. What can be pleasanter to the man who is, "doin' his d—dest" and ins't sure that that is enough, than to have a friend come along and tell him that he hasn't "fallen down on the job?"

For its sins of omission of which it has been involuntarily guilty the Mexican Mining Journal intends to atone in full. This Journal sees in the years to come a great and flourishing mining industry in Mexico, and is determined that this industry shall have a journal worthy of its importance.

The Mining American.

Mining Science of Denver, Colo, has been transformed into The Mining American. In the editorial announcing the change of name, the editor also announces a change in policy. He calls attention to the two distinct classes of mining publications, the ethical, technical journal and the sheet devoted to highly colored reports of properties and stocks, concerning the ethics of which little need be said. The Mining American expects to steer a middle course between these two extremes.

It may not be impossible, but it will require a pilot of extraordinary skill.

Colonel Tepetate.

"I see that the metallurgists claim a bunch of credit for the revival of mining in the States, "remarked the Pessimist. "Those fellow have their nerve all right. What with war prices and plenty of money—there is enough reason for a little activity in mining without calling in those fellows. What is a metallurgist anyway? In the old days when an expert came to camp with that word on his card he mostly got run out of there."

"What's your objection," inquired the Colonel.

"All theories, nothing but theories. Give me a millman who can line up a cam-shaft and isn't too stuckup to sledge in his own keys, and that's the only metallurgist I need."

The old man nodded. "Those old boys were the metallurgists of their day," he said. "They did a lot for metallurgy, perhaps as much as the new bunch who bring all sorts of science to bear on the thing. But, you 're away off if you think they were free from the theory bug. Why, I've listened to discussions by the hour as to what an extra half-inch drop would do to extraction. And every one of those old millmen had his pet dope for improving the yield of bullion. I knew one who fed a chew of tobacco to the batteries once in so often by the clock, and another who wouldn't take charge of a certain mill because he failed to find a particular weed in the neighborhood, a weed upon which he had built his reputation. There was nothing back of those theories but a crazy supersititon. Nowadays they mostly base their theories on a chemical equation."

"Pretty much the same thing, I should think."

"Usually, perhaps, but not always. We have made some advance. People don't, as a rule, expect you to take their theories on faith as they used to do. Even a chemical equation has got to prove itself, these days. But we' ve got a long way to go yet. There is still too much of a tendency to take equations and formulas on trust, to build the mill first and try it out afterward."

"Anyhow, the old-style mining man didn't talk science, science, science, all of the time. He kept his feet on the ground, and you didn't need an aeroplane to follow him."

"Yes, and the old-time mining man recognized no ore unless he saw free gold sticking out of it, and when he built a mill he didn't worry if twenty or thirty dollars a ton went down the creek. He knew only one kind of a deposits, the 'true fissure vein' with 'slickensides,' and his mill was the ten stamps and a copper plate that you still see illustrated in the old catalogues."

The Pessimist sighed. "Of course, "he said, "you musn't think I'm such a mossback that I don't understand times have changed. The old boys wouldn't know what to do with a modern mill and our low-grade ores. But why must these new fellows make a mystery of everything. The mining papers are so all-fired scientific that I can hardly read them. They're full of 'magmatic waters,' 'surface tension,' 'endothermic' and 'reversible' reactions and the like. All the new mining books and most of the articles are written by college professors."

"You'll have to get used to that, for there is going to be more and more of it. If it makes you feel like a back-number, the only thing to do is to dig and get to understand it. If you are wise you will not sneer at this high-brow dope, and you will admit that some fellows know more about some things than others. And you might as well admit that theory isn't science and science isn't theory at all. But you needn't feel like a dub, just because you can't follow all this new stuff. There's so much of it that nobody can. The thing to do is to pick out some particular line and specialize on that. It's the specialists that are doing things these days. There was a time when a mining engineer was supposed to know all there was to it, the cheapest way of getting out ore, how to design and build machinery, and every thing worth while about the complicated business of getting the metal out of the ore. There are plenty of them yet who pretend to be a composite picture like that in one package, but managers and directors are beginning to be suspicious of them."

"And that is why we have geologists and metallurgists and mechanical men butting into the mining game."

"Just about that. There was a time when the barber used to pull teeth and set broken bones and try to cure pneumonia as well as trim wigs and beards. Now we have dentists and doctors of many varieties, and when we get sick we mostly call in a young fellow who hasn't had time to forget about his microscopes and test tubes. The barber no doubt had more personal experience but the young modern medico has back of him the experience of thousands, and what is science but that, accumulated experience?"

"Huh! "grunted the Pessimist. "I see a white-waistcoated capitalist turning over a million-dollar plant to a college kid. Young Absaloms are all right for monkeying around a laboratory or playing with bubbles, but—"

"Speaking of bubbles "began the old man, but a new voice stopped him short.

"Hallo, "it said, "What are you two old crows maundering about? Don't you know that it's time to get busy?"

The face belonging to the voice bore the pallor of the North, and the general appearance of the newcomer suggested an alert energy rather rare in Mexico of late.

"It's Loo-ey! "exclaimed the Colonel. "Where'd you come from?"

"From the border, in forty-one hours. Pullman all the way, plenty to eat, a fine trip."

The Pessimist assumed the look of intense gloom, which is his stock in trade. "See any freight trains?" he inquired.

"Hooray! Through in forty-one hours! "said the Colonel.

"It's sure enough coming this time, "added Loo-ey.

But the Pessimist had gone.

The old man looked after him thoughtfully. "There are a lot of them like that, "he said.

Mine of the Braden Copper Company, Chile.

Teniente Topics, a bright and sparkling little publication, issued by the officials and employees of the Braden Copper Co. in Chile, is giving a series of articles descriptive of the company's properties at Teniente. In the July issue H. R. Graham, superintendent of mines, gives the following on the mines and development:

"El Mineral Teniente," property of the Braden Copper is situated on the rugged slopes of a part of the main Andean Range in latitude 34° S. and longitude 71° 20′ W. at an altitude of about 8,000 ft. The property consists of about 100 claims covering roughly 1,200 acres. The mine is a very old one, dating its history, as stated by Mr. William Braden to the 18th century, when a Spanish lieutenant endeavoring to reach the Argentine from Chile in order to escape the long arm of the law, discovered a high-grade vein in that part of the mine now known as Teniente N. 1. The mine operations up to 1906, however, were on a very small scale, and consisted of a gopher system of mining rich veins, concentrating the contained metal by hand sorting, and transporting it about fifteen miles by mule-back for direct smelting. At that period the operations of the American company commenced in earnest, and from that time on the mine has gradually been enlarged, until it has attained its present 3,000 to 3,500 ton daily output.

The brief description of the mine which here follows has been put in a very general way, so that the average reader, unacquainted with the technicalities of mine operation, could appreciate to some extent the methods of working and the reasons for so doing. If opportunity offers it may be convenient, at some later date, to go into the actual details of the mine operations, giving complete data on the various branches into which the work divides itself.

Geology.

Geologically, the property is pecualiarly interesting inasmuch as it consists of a series of irregular lenses formed about the periphyry of an old volcanic plug, slightly tilted to one side. On one edge the surface has been so eroded, as to have lost completely its mineral values; for active mining operations about four-fifths of the circumference of the crater is left. The volcano itself would rank as a fairly large one, having a diameter of about three-quarters of a mile, and a roughly circular outline about two and a half miles long.

Supposedly of Tertiary origin, the country about the mine consists of andesitic flows through which, at the time of some gigantic volcanic upheaval, the tuff plug now occupying the crater, was forced. The great pressure tore apart and shattered the andesite flows, much as a missile thrown through a plate-glass window would affect the glass. The uprising hot alkaline carbonate waters, containing mineral sulphides in solution, found the cracks and minute fractures in the andesite an ideal place to precipitate, upon the lowering of temperature and release of pressure, and found their way for some distance out into the shattered rocks away from the crater.

The materials close to the volcanic center were so thoroughly shattered that they formed a brecciated deposit, making a most favorable point of deposition; and it is in the brecciated portions of the lenticular ore bodies that the greatest values are found. The mineral sulphides however, formed ore even in the blocky andesite at some distance from the crater. Generally speaking, the materials with which the mine is interested, are the tuff, composing the volcanic plug, a combination of volcanic mud and contained agglomerate; the breccia, essentially of tourmaline groundmass with inclusions of angular andesite fragments; and the andesite, composing the country rock. The tuff is, as a rule, not mineralized except close to the breccia contact, or at such points as fumarolic vents have been formed. The actual contact between the tuff and breccia is not always distinct, but if one remembers that the tuff includes rounded fragments of porphyry, and the breccia, angular fragments of andesite, the difference is easy to detect.

The contact between breccia and andesite is easy to note as a rule, but on the Teniente side the gradation from shattered andesite to andesite breccia, is a most perplexing one. The breccia does not always appear as an intermediate material between the tuff and the andesite, but in these cases where tuff and andesite contact, the ore width is not so great nor the values so rich. At various places in the mine old fumaroles are encountered, in which oxidation has taken place at depth, and at times small chambers containing beads of wire copper coated with oxide, are found in company with the usual black sulphides, and oxides, and yellowish iron stains of limonite.

The limit of ore on the crater side is generally the tuff, although sometimes false contacts—thin tongues inserted into the breccia—occur on the inside of which there is good ore bearing breccia. On the country rock side, the limit of ore has to be determined by assay, but is also detectable by the lessening of the fractures and the blockier, more entire appearance of the andesite.

The copper values occur in both breccia and andesite, essentially as primary sulphides in the form principally of chalcopyrite, wich is roughly 75 per cent of the copper mineral, and also as bornite, secondary chalcocite, and undetermined black sulphide between tetrahedrite and enargite, and some of the carbonates, silicates, sulphates, and oxides of copper. Zinc blende, iron pyrites, magnetite, galena, and occasionally native copper are also found. Tourmaline, quartz, calcite, ferromagnesium carbonates, and the usual products of devitrification, chlorite, kaolin, etc., are also found, as well as the plagioclase, biotite, hornblende, and pyroxenes of the different classes of andesite.

Topography and Plant.

The topography, due to violent igneous origin of the region, is very steep and rugged, devoid of vegetation, particularly liable to strong winds, heavy snows and snowslides. It it this topography which at one and the same time aids mining, drainage, and ventilation, by allowing the mine to be opened by adits, and still makes difficult the operation, by its lack of safe room for buildings, and storage of supplies, and by its difficulty of access.

Great care has to be exercised in the choice of building sites, as we have found by experience that the Cordillera guards its wealth rather jealously, and one bad storm is sometimes enough to change all previous slide paths and wipe out even buildings that have stood up for years.

The surface plant consists of a power house, with necessary compressors for a steady compression; motor generator sets, for the transformation of about 600 K. W.; and switchboard installation, for handling of about 1500 K. W. at a 2300 voltage. Power is sent from the substation at the Cañon Diablo, three kilometers distant, by two separate pole lines, which are subject to winter breakdowns due to slides.

The machine shop is fully equipped with lathes, a shaper, drill presses, pipe machines, shears, and a punch, and takes care of mechanical repairs. A blacksmith shop, complete with forges an air hammer, rolls, drill sharpeners, etc., attends to all heavy work and drill sharpening.

The carpenter shop with saws, a planer, and a woodworking machine, does all the carpenter work. And the bodega, almacen and bakery see to the supply of necessary materials, both for the work and living.

All water necessary for plant use, drinking, washing, and sanitary purposes, is secured from the so-called Teniente lakes, some 500 meters from the Fortuna No. 4 tunnel, and is supplied to the upper levels by pipe lines from a pump on this level.

All power, light, telephone, and air lines are carried underground to avoid snowslide and wind danger. Communication is secured between all levels both by underground workings, and by aerial tramways by means of which supplies are delivered. An electric railroad connecting the lowest level of the mine No. 5, with the coarse ore bins at the mill delivers the mine ore, and at the same time brings up the greater part of the supplies. The aerial tramway, connecting the mine and mill now called Sewell in honor of the late president of the company, is used almost entirely as a store delivery system, but in cases of emergency can deliver ore. It is at present motor driven, handling ore occasionally.

The equipment, consisting of the necessary motors, compressors, shop tools, haulage motors, cars drills and accessories, were all sent from the United States; the labor has been practically all Chilean.

Townsite.

The main townsite consisting of some 1,000 people in winter, and about 1,500 to 2,000 in summer, is accommodated on the several small hills bounding the snowslide gulches, and is called the "Pueblo Hundido." It consists of a general office building, hotel, engineering office, assay laboratory, three staff houses, three cottages, one large stone building accommodating several families, and about ten rows of buildings composed of two-room family quarters, men's bunk houses and boarding houses.

On the upper levels of the mine live between 500 and 800 people, who are housed either in large rooms cut in the rock, or else in wood and calamina houses perched on the hillsides.

The mine consists of three principal ore bodies: the Fortuna, the Regimiento, and the Teniente, with a total tonnage of about 90.000,000 tons, developed and probable, with good prospects for largely increasing this tonnage by future development. The two smaller ore bodies, of secondary importance, but included in this tonnage are: the Centinela, and the Bornite. The Teniente ore body is now being developed to an operating stage. The full extent of ore in this section has not as yet been determined.

The Fortuna ore body, from which all the ore at present is being won, is operated by the principal levels; Fortunas Nos. 2, 3, 3½, 4 and 5, and by sub-levels Nos. 2½, 3¼ and 4½. With the exception of levels Nos. 3½ 4, and 4½ shrinkage stoping operations have been nearly completed, and caving is now in progress.

Methods of Mining.

The mining divides itself, naturally, into three important operations. viz: Development—finding and proving what deposits there are and their extent; Stoping—the preparatory weakening of the great ore body; and Caving—the final step in the ore recovery. All these operations are now going on in the mine.

Development work consists of driving adits along the contact of the tuff with breccia or andesite in order to locate the ore; and then when once located, to determine the tuff contact, or one side of the ore, by crosscutting, and also the limit of commercial ore on the opposite side. Once ore is reached, these crosscuts are put in about every 34 meters, and in this way, blocking out every 100 feet, the plan area of the ore at that level is determined. The extent of ore was first determined in the Fortuna on the No. 2 level, then blocked out on the No. 3 level in the same manner, and the ore between them proved up by inclined raises running from the tuff to the limit of commercial ore and back, to ultimately connect to the level above. The tuff side is commonly known because of its inclination, as the hangingwall, and the limit of commercial ore as the footwall. After a block of ore is outlined, the crosscuts used in developing the body are utilized as starting points for the actual mine operations. In these crosscuts small raises, at from seven to eight meters centers, are driven up into the ore at 45° until the face of the raise, reaches the far side of the stope. In some cases, this is ten meters on the incline in the old system; in the present Teniente system it will be about five meters. When this drive is completed, a timber chute with an arc gate is erected. A machine of the standard hammer drill stoper type is put to work; and these various raises are connected, one to the other, by a belling out process, which ultimately leaves a series of circular holes. These at last extend across the ore body, the hole on the hangingwall side showing tuff, and the hole on the extreme footwall end assaying the commercial limit.

In the meantime, in the pillar left between each two of these sets of openings, an inclined raise has been driven, and at a point about twelve meters vertically above the level a horizontal working, known as cruzado, is driven from the raise to the room formed by the joining of all the chute holes. This room is known as a stope. It is really a big underground room, of a width depending on the kind of rock, but generally 22 feet, and a length dependent on the width of the ore body, but ranging between 60 and 350 feet.

Once the cruzado, is connected the chutes are allowed to fill up with broken ore, and after that all communication between stope and level is by these cruzados. The stope is filled with broken ore to within about six to eight feet of the back, and then trimmed into shape by means of carefully placed holes with the hammer drills. Pipe lines are run up the inclined manway raises, and by means of wire wound hoses, air is supplied to the rooms for ventilation and for the operation of the hammer drills. Once the stope is "lined up," machine drillers start work in the ratio of about one drill to every forty feet of stope length. An average drill shift consist of fifteen 5 foot holes per machine, which should break with one and a half sticks of ordinary 34 per cent gelignite per hole, about 60 tons of average stope rock.

On the principle that each cubic meter of rock in place occupies 1¾ cu. m. when broken, it is possible then to draw out 24 tons for each 60 tons broken, and leave the same six to eight feet between the unbroken back and the broken ore pile. No holes are drilled in the center of the stope; but each drill, safely placed

at the extreme wall of the stope, drills one vertical hole, and one slightly inclined hole toward the center of the stope. Then at a five foot distance, the miner drills two more similar holes, and continues thus until his shift is over. By alternating this process from one side day shift, and the other side night shift, a great deal of rock in the center of the stope is robbed of its side supports, and has to fall by itself, which tends to cheapness. All stope work is done on contract price per foot of hole. Additional men are employed to deliver steel to the stopes; mechanics repair machines and keep air lines in shape; and on the level below, hand trammers of motor haulage cars continually draw off the excess break to leave the working space necessary between the back and the ore pile.

Stoping.

This stoping operation goes on continually, raising higher and higher on the broken rock, until the back reaches a point some thirty feet below the level above, at which point a final blast to fill the stope is placed, and the work discontinued. The raises in the pillars are continued to connect to the level above for ventilation, and as one pillar raise is run in the hangingwall end, and in the next pillar in the footwall end, each stope always has at least two entrances and a continuous natural ventilating draft. The drillers load and blast their own shots, and each shift at fifteen minutes before quitting time, has all its holes ready to spit. When the raising of stopes is finished, the stopes are left filled, until caving operations above have been completed.

The best arrangement of stopes as developed here, to suit the ground, and as will be used in the Teniente, is to have a seven meter stope and a five meter pillar, which in the case of bad ground, can be changed by narrowing up the stope and increasing the pillar, without having to change in any way the level workings. Chutes are best spaced about seven meter centers, and it has been found by experience that fifty meter differences in elevation between levels are most easily worked. Each stope has its crosscut immediately under it, and running parallel to it, i.e, across the width of the ore body.

In the beginning of operations no timber except chute sets and a slight amount of material for crossings and station sets is needed; but when stoping operations cease and caving begins, more timber is necessary to hold open the haulage drifts. As the whole success of caving depends on the superincumbent pressure that can be brought to bear on the unbroken pillars, it is necessary to secure weight as quickly and as evenly as possible, and that means heavy ground on the haulage ways. These ways then have to be timbered, relieved, caught up, angle braced, and kept in repair.

The process of caving consist of cutting off the pillar at the footwall and hangingwall by means of small stopes, or by running raises in which great blasts are exploded, either electrically or with fuse, and then by running a pillar drift along the bottom of the pillar immediately above the level, and blasting a series of pits here, the pillar is completely cut off and has to fail. If by any chance it tends to arch, this arch is broken by a heavy blast. The material resulting from the chute blasting is pulled out, and the pillar caves down to occupy the space left.

Te most important consideration is the securing of even weight, and then an even pulling, so that the extraction is not spolled by waste admixture. Definite data is kept on every chute; its expectancy above the level figured, and its extraction calculated when waste definitely appears. Careful chute sampling is done on the caving level, and chutes running below commercial grade are abandoned unless it is known that the chute has ore above it. In case there is known ore above, and the waste is merely a little fine material that has sifted through, the chute is run; the material sent to waste, and samples taken until it runs ore again.

Active caving is taking place on the Fortuna Nos. 2 2¾ and 3 levels, and in the small ore body on the Fortuna No. 4 level known as the Bornite, caving has been fully completed, and the full percentage of the estimated tonnage has been recovered. Fortuna No. 4 and Fortuna No. 5 are at present essentially haulage levels, to transport the tonnage from above in the mine out to the mill. Fortuna No. 4¼ is now opening up a continuation in depth of the Bornite ore body below Fortuna No. 4, and on the Fortuna No. 5 level advance headings are being driven under both Fortuna and Teniente sides of the crater to prepare for increased operations.

Electrolytic Zinc Process Developed in Canada.

Very promising results are being obtained in several different places with a sulphatizing roast followed by leaching with sulphuric acid and electrolytic precitation of the zinc. This follows very closely the recent work in the hydrometallurgy of copper. The ore may be given a preliminary treatment by some form of concentration, in order to get zinc content in smaller bulk. This may be done on tables or jigs, or a flotation concentrate may be produced.

The concentrate, or the original ore, is roasted at a temperature of 700° to 750 °C. for from five to six hours, and then leached with a solution containing 12 to 15 per cent. sulphuric acid. The acid is neutralized with excess of roasted ore. The solution is oxidized, and iron is precipitated, by zinc oxide. Copper if present is thrown down with metallic zinc (zinc dust). The solution is then made quite acid and sent to the precipitation tanks, where it is electrolyzed, using a hard lead anode, and in some plants, a current density of 100 amperes per souare foot of cathode. The cathode zinc, firm and very pure, is then melted into bars.

The ore residue after extraction of the zinc may be smelted for its lead and silver, and is more valuable to the smelter with the zinc removed.

Test for Tungstic Acid.

Some simple prospectors' reduction tests for tungstic acid are described by G. Torossian from which two are selected.

Place the powdered substance on a piece of aluminum plate or foil; moisten with a drop or two of water; then add a drop or two of concentrated hydrochloric acid. A blue color, which develops even in the presence of oxidizer and ferric oxide, shows tungsten.

Another test is: Place water in single big globules (not spread out) on aluminum foil; sprinkle a little of the finely powdered material on them, and add a little hydrochloric acid to the globules. A blue color, developed in the presence of insoluble carbonaceous material, copper oxide, hematitie, lead oxides, sulphur, rare-earth oxides or calcium fluoride, shows tungsten.

The Mexican Oil Fields.*

The occurrence of oil "tar" in Mexico was mentioned as early as the seventeenth century by Friar Sagahun, who gives the Indian name "chapopote," by which these asphalt seepages are still called. This asphalt was apparently used, as it has been used by primitive people in many parts of the world, in religious ceremonies and for medicinal purposes. Travellers also report that the ruins in Yucatan and the pyramids in southern Mexico show traces of the use of "chapopote" as a building cement.

De Golyer says that the first attempt to exploit oil or gas in Mexico in a commercial way is shown by the records of the Memoria de Fomento of 1865, when permission was granted to a Sr. Ildefonso Lopez to exploit the deposits of petroliferous substances in the San Jose de las Rusias area in the State of Tamaulipas. Other concessions follow, and probably refer to surface seepages which occur in that district. This was several years after the discovery of oil in Pennsylvania. In 1868, a well 125 ft. deep was drilled by a company organized in Mexico City, in what is now known as the Furbero district, and a little oil was refined there.

In 1873, residents of Tampico denounced seepages along the Tamesi River, and asphalt was mined near Tempoal in the Canton of Tantoyuca. No drilling was attempted. But between 1880 and 1883 several shallow wells were drilled for oil in Mexico, two of them being near the present Potrero de Llano field west of Tuxpam. The wells were drilled by a Boston company with Canadian rigs, and are said to have reached a depth of about 400 ft., while one is reported to have flowed. Several other abortive attempts were made to drill for oil between 1885 and the beginning of the present century, about which time the Mexican Petroleum & Liquid Fuel Co., Ltd., in which Cecil Rhodes was interested drilled 24 wells unsuccessfully, several of them as deep as 1,500 ft., in the State of Vera Cruz. Also Messrs. Doheny and Canfield of California purchased land in the State of San Luis Potosi, and in May, 1901, the first successful well was struck in the present field of Ebano, 50 miles west of Tampico. Various shallow wells were drilled about this time in the States of Vera Cruz, Tamaulipas, near Guadalupe, Chiapas, and Tabasco on the Isthmus of Tehuantepec; and several asphalt companies attempted to mine the surface deposits in the Cantons of Tuxpam and Ozuluama.

In 1904, drilling was commenced by the Oil Fields of Mexico Co. (Pearson interest) at Furbero, and its first well was brought in successfully. Pez No. 1, the first large well on the Ebano property, was also brought in during the same year, and has flowed continuously since. About 1907, drilling became more active, especially in the Cantons of Tuxpam and Ozuluama. It was started at San Diego by the Pennsylvania Oil Co., at Tumbadero by the Pearson interest, and at Juan Casiano and Tres Hermanos (La Pithaya) by the Huasteca Petroleum Co. A Mexican bank drilled four shallow wells near the Tampalache seepage, just north of the Panuco field. Operations were also commenced by Pittsburgh interests at Los Esteros, in the State of Tamaulipas.

In 1908, the Pearson refinery at Minatitlán on the Isthmus of Tehuantepec commenced operations. In May of the same year San Diego No. 2, the discovery well of the Dos Bocas field, came in with a production of 2,500 bbl. daily. On July 4, the famous San Diego No. 3 was brought in, caught fire immediately, and burned until extinguished by encroaching salt water. The Chijol field in the Ebano district and the Topila field were brought in during this year, which inaugurated important operations in the Mexican oil fields.

The year 1910 saw the discovery well of the Panuco field (East Coast Oil Co. No. 401) drilled, and the first well in the Tanguijo and San Pedro districts were put down in that year by the Pearson interest, the Mexican Eagle Petroleum Co. The Huasteca Petroleum Co. also brouht in its No. 6 and No. 7 Juan Casiano, one with 14,000 bbl. and the other with 28,000 bbl. daily production. About the time these came in, this company completed its 8-in. pipe line from that field to Tampico. The Mexican Eagle Co., having completed its pipe line from Furbero to Tuxpam, brought in, in December, 1910, the famous Potrero del Llano well, yielding about 100,000 bbl. daily. Drilling was by this time very active; and in 1911 the first exportations of crude oil were made to the United States from Tampico.

In July, 1912, the Government put a tax of 20 centavos per metric ton (1.1 c. U. S. gold per barrel) upon all oil produced in the Republic. The construction of a large fleet of tank steamers had already been commenced by the Huasteca Petroleum Co. In 1913, the Penn-Mex Fuel Co., now a subsidiary of the Standard Oil Company of New Jersey, through the South Penn Oil Co., brought in two good wells in the Alamo field near Potrero del Llano. The Chila-Salinas and the Topila field began to suffer severely from the invasion of salt water. The Mexican Eagle Co. brought in the discovery well in the Los Naranjos field in Amatlan, which has since broken its valve and proved to be a much larger producer than was estimated by flowing at the rate of 50,000 bbl. per day for a week. On December 1, the Government raised the production-tax to 75 centavos per ton (aproximately 4c. U. S. gold per barrel) besides increasing numerous duties affecting the petroleum industry. A bill was proposed in the Chamber of Deputies for the nationalization of the petroleum industry, but no decisive action was taken.

During January, 1914, the Dutch Shell interest (La Corona Petroleum Company) brought in its big well, which is estimated to have a capacity of 100,000 bbl. per day, in the Panuco field. During the spring of this year the activity of both the Federals and the Constitutionalist became very great in the vicinity of Tampico, culminating in a general exodus of the foreign employers of the oil companies in April, at the time of the Vera Cruz affair. Operations came to a standstill for a time, but the foreign employees gradually returned during the next two months, and restricted drilling was carried on by some of the larger companies, especially in the Panuco field. But continued guerrilla warfare, led to heavy demands upon all companies, so that affairs in the oil fields were by no means normal when the European war broke out in August. In addition to this, lightning set fire to the big Potrero del Llano No. 4 well, which was not

*From a paper by L. G. Huntley presented at the September, 1915, meeting of the A. I. M. E. San Francisco Cal.

entirely extinguished until after the end of the year. During the latter part of the year hardly a string of tools was running.

Production.

The following table shows the annual production of petroleum in the Mexican fields since 1904. Within the last three years, this has not represented the productive capacity, which was much greater. The completion of additional transportation lines to seaboard, the building of more tank ships, and the lessening of the over-production of high-grade oil in the United States, together with the broadening market following the end of the European trouble, will see the production of the Mexican fields advance enormously. At present they are yielding only about 70,000 bbl. per day; but the wells already drilled could produce 330,000 bbl. per day. In fact, the latest figures on good authority make this capacity more than 500,000 bbl.

Production of Oil in Mexico.

Year	Barrels (42 gal.)	Year	Barrels (42 gal.)
1904	200,000	1910	4,099,000
1905	300,000	1911	13,655,488
1906	500,000	1912	16,844,066
1907	1,000,000	1913	24,574,500
1908	3,481,000	1914	25,725,403
1909	2,765,000		

During the latter part of 1914 there were 56 companies actually operating in the Mexianc fields. But some 200 companies had been organized and were engaged in the business in one way or another. Most of these were American companies, the exceptions being the Pearson interest (English), the Dutch Shell interest (English and Dutch), and a number of Mexican companies particularly in the Panuco and Topila field. The principal shippers of petroleum were the Mexican Eagle Oil Co., Ltd. (Pearson); the Huasteca Petroleum Co. (Doheny); the Tampico Company; the Mexican Gulf Oil Co. (Mellon); the East Coast Oil Company (Southern Pacific Ry.); the Trans-continental Petroleum Co. (John Hays Hammond); La Corona Petroleum Co. (Dutch-Shell); the Panuco Valley Oilfields Corp., Ltd. (Simms & Bowser); and the Penn-Mex Fuel Co. (Standard Oil Company of New Jersey).

Not more than 50 wells were actually producing, and more than half of the oil produced came from about six of these. The rest were shut in, waiting a better market, or better transportation, or for other reasons more or less connected with business policy, which sometime isncluded the obtaining of additional territory or the clearing up of titles.

The estimated total daily capacity of all wells in the Mexican fields of 330,000 bbl. may be divided among producing fields as follows, at the beginning of the present year:

Northern district, producing heavy oil, form 10 to 14° Bé.

Barrels.
150,000 Panuco
4,000 Topila
6,000 Ebano

Southern district, producing oil from 18 to 27° Bé.
65,000 Casiano and Los Naranjos
100,000 Potrero, Alazan, Alamo, Tanguijo, and other points shipping from Tuxpam.

Note.—The Huasteca Petroleum Company's production at Cerro Azul and Juan Felipe has not been included through lack of information; but it is claimed that these wells are capable of adding 175,000 bbl. a day to this estimate, making the total 500,000 bbl.

While these figures indicate what might be expected of the Mexican fields if transportation and marketing facilities were to make it possible for all wells to be drawn upon to their full capacity, yet as a matter of fact, the year 1914 saw only an average of 70,000 bbl. per day of actual production distributed as follows:

	Barrels
Topila	398,679
Southern fields	18,830,359
Panuco	5,058,970
Chila-Salinas, Ebano, Chijol,	1,108,995
Tehuantepec	382,500
Total Production	25,725,403

This was consumed or stored as follows:

	Barrels
Clearances	20,674,357
Internal consumption	1,172,898
Refinery products	2,000,000
To storage	1,888,148

The addition to stocks brought the total storage in Mexico at the beginning of the year to 15,127,834 bbl. as follows: In steel storage, 9,658,258 bbl.; in earthen storage 5,369,576 bbl. (including 508,690 bbl. unmerchantable.)

Clearances from Mexican ports were distributed as follows during 1914:

	Barrels
To the United States	15,476,727
Mexican Coastwise	4,510,061
South America	195,138
To the Continent (Europe)	356,205
To the United Kingdom	69,780
To Panama	46,446
To Cuba	20,000
	20,674,357

It is not to be expected that most of the producing districts in the Mexican fields will decline in a manner similar to the sand pools of the United States. It has been proved that the estimated initial capacity in many wells would be equaled if not surpassed by actual performance if they were allowed to flow freely. In fact, wells such as the Juan Casiano No. 6 and No. 7 and Los Naranjos No. 1 and No. 4, and the Mexican Fuel Oil Company's No. 3 Zurita, all in different districts, increased their production after being allowed to flow, as shown below:

Juan Casiano, No. 6	10,000	14,000
Juan Casiano, No 7	20,000	28,000
Los Naranjos, No. 1	5,000	10,000
Los Naranjos, No. 4	10,000	50,000
Zurita, No. 3 (Panuco)	30,000	80,000

These cannot be considered exceptional cases, since so few of the large wells have ever been allowed to flow freely. Considering geological conditions, such behavior is to be expected. The oldest commercial wells in the Mexican fields (Pez No. 1 in the Ebano district, and Juan Casiano No. 7) after producing since 1904 and 1910 respectively, and from widely separated districts have shown practically no decrease in their flow since they were drilled in. The famous Potrero del Llano well, in the southern part of the field, has never produced up to its capacity and is still yielding as much as ever. These last two wells have produced approximately 40,000,000 bbl. of oil each during their history, and show practically no signs of de-

cline, so far as known. The same may be said of the oldest well in the Panuco field (East Coast No. 401), drilled in 1910. This is even more remarkable, since the area surrounding this well has been closely drilled. While a few of the smaller wells at Panuco showed a decline after being shut in for a time, yet this apparently did not indicate any exhaustion, for at the same time No. 3 Zurita increased its production, as indicated above.

It must be said that producing conditions in Mexico differ fundamentally from the fields in the United States, and that, by reason of these conditions there is no vital need on the part of producing companies to bring the oil to the surface as quickly as possible (as at Cushing) and hence relatively little necessity for large tankage—except at terminal stations for operating reasons. The Mexican oil production comes from about 20 different distinct groups of wells. In all except Panuco and Topila, one company usually controls a large acreage surrounding its group of well. Hence, each of these 20 districts represents a pool, or geological unit, in which only a few initial wells have been drilled. It is thus to the interest of each company to drill efficiently, and to keep wells shut in when there is no market or no transportation. There is usually no waste of oil or gas, except in the case of accidents, or inability to control a well. One of the few cases of waste happened recently, where a company struck a gas well south of the Topila field, which it is allowing to blow wide open, hoping it will show oil. This is almost the ideal condition advocated by some conservationists in this country—one company to each pool.

There has been very little decline of pressure as yet, even in the older pools; and wells such as the first ones at Ebano and Juan Casiano, producing since 1904 and 1910 respectively, are doing so at practically their original rates. In the latter case 40,000,000 bbl. of oil have been taken from the one well, with not more than 10 per cent. decline from its initial daily production. If this locality had been drilled up, as was the case at Cushing, probably it would almost have ceased to produce by this time, and might not have produced as much oil from all wells as will be obtained from the few holes which will be drilled by the present company.

Oil from the Ebano district is used largely as fuel by the Mexican railways, and considerable asphalt for paving also goes by rail. The Panuco oil all goes in barges to terminals near Tampico, and thence in tank ships to destination. The other fields all pipe their oil to seaboard either at Tuxpam or Tampico, where it is taken by tankers. There are at present 427 miles of pipe line in Mexico, mostly 8 in., some is 6 in. and smaller. About 50 miles additional are building or contemplated. The principal lines are as follows.

East Coast Oil Co.; 8-in. line, Panuco-Ponce; about 13.65 miles completed of a 24-mile line to Tampico.

Mexican Eagle Co. (Pearson); 8-in. line, Potrero del Llano to Tuxpam; 8-in. line, Potrero del Llano to Tierra Amarilla, to Tanguijo, to Tamihua, to San Sebastian, to San Diego, to Bustos, to Tampico; 8-in. Los Naranjos to San Diego. (An allied company has a 6-in. line from Furbero to Tuxpam).

Huasteca Petroleum Co. (Doheny); two 8-in. lines from Cerro Azul to Juan Casiano; three 8-in. lines from Juan Casiano to San Geronimo, to Esperanza, to Tankville, to Tampico; and a gas line from Juan Casiano to Tampico.

Penn-Mex Fuel Co. (South Penn Oil Co.); 8-in. line from Alamo and Agua Nacida to Tuxpam; 4-in. water line paralleling above.

Transportation is a serious difficulty in getting Mexican oil to the market. Present equipment could not possibly handle the full production of all wells hitherto drilled, which is variously estimated from 330,000 to 500,000 bl. per day. In 1913, the production of these wells was 24,574,500 bbl. During 1914 none of the old wells declined in production, and 32 new wells came in, representing a possible new production of 196,000 bbl. per day. During the same year a number of pipe lines were enalrged from 6 in. to 8 in., and at least one new field (Los Naranjos) was connected with the seaboard. Shipping facilities from the Panuco field were increased, and some new tankers went into service. In spite of all this new production and new equipment, the field yielded only 25,725,403 bbl. of oil during 1914. At the present time not more than 50 miles of additional pipe line are under construction or contemplated, and very few new tankers, considering this great shut-in production. This indicates that companies are awaiting a better market before making a serious effort to get their product from wells already drilled to points of consumption. Afield with a possible daily production of at least 330,000 bbl., which meanwhile only produces 70,000 bbl. per day, and at the same time makes little effort to build new pipe lines and tankers, as indicated by present constructions under way, furnishes strong evidence of the effect of market conditions.

Proposed Export Tax in Perú.

The mining industry of Peru after enjoying immunity from special taxation for 18 years, now faces a serious problem in the proposed export-tax bills, which have been drafted by the Consejo Superior de Minería and which will be acted upon by the Peruvian Congress in November. The "West Coast Leader" of July 1, 1915, publishes some of the proposed tariffs and discusses the effects that such taxes may have on the mining industry of Peru:

When the period of 13 years was set for the free exportation of minerals from Peru, it was doubtless considered that in this time the industry would achieve such prosperity and vigorous life that it could well afford to pay a special contribution into the coffers of the state. Unfortunately this has not been the case. Railway development, the primary factor in exploiting the natural resources of Peru, has fallen thousands of kilometers behind the expectation of two decades ago. In fact, during this period there has not been a single line of the first magnitude constructed. With the exception of the connections established by the Cerro de Pasco company, the principal mining districts are as remote from important railway lines as they were in the days of Pizarro. The casual reader may pick up any one of a dozen articles on mining possibilities of Peru and find somewhere the damning information

PROPOSED AND EXISTENT EXPORT DUTIES ON COPPER*

Peru [probosed]		Chile [proposed]		Bolivia [existent]	
London Quotation, £	Tax L.p.†	London Quotation, £	Tax converted to L.p.	London Quotation, £	Tax L.p.
50-55	0.2.50	55.60	0.9.00	50	1.0.40.
55-60	0.5.00	60-65	1.3.10	51-60	1.6.00
60-65	0.8.32	65-70	1.8.75	60-70	1.8.40
65-70	1.2.20	70.80	2.8.25	70-80	2.0.80
70-75	1.7.07	80 and up	3.7.50	80-90	2.3.20
75-80	2.2.85	.....	.....	90-100	2.5.60
80-85	2.9.70	.....	.....	100 and up	2.8.00
85-90	3.7.60	.....	.....	.....	.....
90-90	4 6.70	.....	.....	.....	.....
95-100	5.7.00	.....	.....	.....	.....
100 and up	6.6.10	.....	.....	.....	.....

* As reported by the "West Coast Leader." With copper selling at 17c. per lb., the proposed tax on, say, a 50,000-lb. production in Peru by Cerro de Pasco would mean an annual tax of about $250,000. In Chile the proposed tax would cost the Chile Exploration Co. over $600,000 annually for a production of 120,000,000 lb.
† L.p.=libra peruana, equivalent to the pound sterling when exchange is at a parito.

that such and such rich deposits are "too far from railway or water transportation to be worked profitably." The mining industry of Peru, in other words, is still in its infancy. Its future prosperity depends on that magical touchstone of all new countries—the ingress of foreign capital.

The ingress of foreign capital depends primarily upon the wisdom and farsightedness with which the Government formulates its laws and regulations pertaining to the exploitation of the natural resources. The vital question now awaiting resolution is how heavy a mortage the lawmakers of Peru will place upon the future of the mining industry in order to obtain a few thousand pounds ready cash for the exigencies of today.

The "West Coast Leader" presents for comparison the proposed export tax on copper now before the Chilean Congress and the export tax actually in existence in Bolivia. The high scale of both of these countries in comparison with the proposed Peruvian scale is, it says, easily explainable through the fact that in Chile the transporttation of mineral products from mines to ports is comparatively easy; in Bolivia, the principal producers work a native copper ore which is easily reduced.

The Sociedad Nacional de Minería has submitted to the council its protest against the proposed measures as they stand, claiming they will be oppressive to the mining industry and subversive in ultimate effect on the progress of the country, as well as on the people directly employed in mining. Mineral exports in 1913 were 46.82 per cent. of the total exports of the country. The Committee on copper recommended that the proposed tax of L.p.0.2.50 per metric ton, instead of applying to the London price of £50-£55, begins at £65-£70, and continues upward as shown in the table to a maximum of L.p.3.7.50 when copper is £100 or over in London.

The main sources of revenue from the proposed tax in Peru will of cource be the Cerro de Pasco and the Backus & Johnston companies. Notwithstanding that these companies will be badly affected by the new tax, the small producer will be in a still more hazardous position. The discouragement of the small producer or of the operator of moderate size will mean a serious setback to the mining industry of Peru. It is putting a premium on the sort of development that took place in Peru from the 15th to the 20th century, instead of the building up of such industries as that of Cerro de Pasco, which has spent over $25,000,000, built 125 miles of railway, and furnishes steady employment for several thousands of people in its various towns.

Geology of Cerro de Proaño, Fresnillo, Zac.

In view of the reports that the Fresnillo Co. shortly intends to resume operations on its Proano properties at Fresnillo, Zac. the following notes on the geology of the cerro, written same time ago by John A. Church for the E. & M. J. will be interesting. The Fresnillo Co. has built two mills at Fresnillo, one to treat the tailings left by former operators and another to treat the extensive orebodies still left in place.

In the State of Zacatecas, Mexico, a mile from Fresnillo, there is a low, round hill only 325 ft. high, and 2500×3500 ft. in diameter at the base. It stands nearly alone with wide valleys on all sides, except toward the east, where the country is rolling. This is called the Cerro de Proaño, the Hill of Proaño, from Manuel Proaño, a Spaniard, who found ore there in 1515. It is the seat of remarkable crushing and shearing forces with subsequent mineralization by waters which carried silver with some gold, but appear to have been weak in silica. There is nothing unusual in the situation except that, if we may trust the Mexican miners, this mineralization was confined mainly to the limits of the little hill, and did not extend beyond it except on the west side, and apparently not far there. There are veins in the ground east of the hill in abundance, but they did not prove to be rich enough to be worth working. At least, that is the lesson to be read from the frequent attempts of the old miners to make mines in them both by surface and underground work, always with rather speedy abandonment.

Early History.

How much mining Proaño and his successors of the very early days did is not known, but certain very irregular and narrow openings that are seen at many points are supposed to be their work. Mining is reported in 1715 and vigorous mining in 1751, but the records of production available do not go back further than 1832, when the State of Zacatecas took possession of the mines on the mistaken theory that their product would be a relief to taxpayers. Revolutionary troubles brought that period to a close in 1835, when the mines were turned over to the Compañia Zacatecana Mejicana, which worked them until 1872, a period covering the introduction of steam power for pumping and moving the arrastras. The "crime of '72" brought that enterprise to an end, and the mines were located by Señor Ortego. The Compañía Restauradora de Fresnillo began work in 1879, which was continued later by the Compañia de Fresnillo. Both of these concerns treated surface ore and made so much money that they were encouraged to pump out the deep mines, but soon lost their encouragement, closing down in 1903.

The yield of the mines in this working period of 67 years was very considerable, having been as follows: 1832-35, $6,454,696.84; 1835-72, $41,341,850.89; 1897-03, $4,784,030.51; total $52,580,578.24. These figures were ascertained by going laboriously over the old mine books, which are in perfect preservation. From the Mexican point of view these books are elaborate and exact, but they lack the figures of cost, which modern practice finds valuable.

The fact that the mines produced a yearly mean of nearly $800,000 for the long term of 67 years, points both to great activity and to at least a good grade of ore. It is conjectured that a million and a half tons of patio tailings are banked up or scattered by the torrential rains over the valley, and these would give an average value of $35 a ton. The mines were visited early in the last century by several well known metallurgists, who reported the losses at 25 per cent. In 1814-42 the ore yielded 40.8 oz. per ton, and the loss was 8.75 oz. An assay office was established when the great hacienda was built, about 1840, but it was abandoned for the odd reason that its work did not correspond to that in the large way.

There are two deep shafts, 1200 and 1400 ft., and many that exceed 500 ft. The deep working did not exceed 900 or 1000 ft., but down to that depth it was

very extensive. All these deep openings are full of water and though the hill above the water is a veritable honeycomb of irregular openings and connecting passages by which in old times it was possible, I presume, to reach every stope and drift in the hill from every other, but these are mostly inaccessible now.

Proaño is notable for two incidental results produced by its wealth. The State built a school of mines there, and young men had the benefit of study in an important field of characteristic Mexican mining. The scale on which this instruction was prepared can be judged by the substantial and graceful building, which is about 125 × 150 ft. in size. The other result was the construction of the largest patio in Mexico, and therefore in the world. It is 1150 ft. square, is walled in completely, and has buildings around most of its circuit. It was capable of treating 350 tons of ore a month, and cost $340,132.79. It was finished about the time of the war with Texas, and the Government forced loans of $1,292,713.43 from the company. Coming just while the improvements at the mines were in progress the company found itself $2,563,675 in debt, but during the next 10 years the output was $14,951,318. As the cost of mining and treatment were reduced in this patio from $24.28 to $16.50, the saving must have been about $300,000 a year. The company paid $2,437,915.89 in the first 12 years of operation.

Geology of the District.

The geology of Proaño was studied by Prof. Pascual Arenas, of the National School of Mines in Mexico (City), who says that the hill is composed of "vacia gris metamorfica," which is translated "graywacke," and this formation he extends across the valley to the prophyry hills miles away. He gives the following estimate of thickness: 1980 m. of graywacke; 290 m. of wavy clay slate; 310 m. of calcareous slate and shale; 1700 m. of metamorphic ("transition") limestone; 590 m. alternations of clay slate, graywacke and limestone; total, 4870 m. This geological column will have to be revised for the "graywacke" that forms the top of the is rhyolite, which lies on the slate. The deep shafts are opened at the foot of the hill, and more than half their depth must be in slate. The extension of the rhyolite or "graywacke" over the valley is only supposition for the actual floor of the valley is the recent limestone caliche. Prof. Arenas thought the sedimentaries are Devonian. No fossils are found, but he correlates the Proaño measures with those of Zacatecas.

The rhyolite is a strongly altered aluminous rock, which shows little silica or other inclusions. Analysis of some ore samples gave 70 per cent. insoluble. Burkart says that "in the San Francisco shaft (1400 ft. deep) the dark-colored clay slate alternates with very thin fine grained layers of graywacke which give the rock a banded appearance."

Remarkable Development of Veins.

The noticeable characteristic of Proaño is the remarkable development of veins in all directions, and with all possible dips. Judging from the maps made by Professor Arenas there cannot have been any great movement of blocks upon each other or it would have been imposible to draw the long straight lines by which the geologists expressed their conception of the vein system, and which are justified by the few observations whihc can be made now.

The whole system of veins may be said to lie in a N.W.-S.E. direction, and they have the extraordinary peculiarity of dipping with the slope of the hill on whatever side they outcrop. There are also many N-S veins, and I presume they dip both ways, too. The old explanation for this complexity was that veins of similar dip belonged to the same period of formation.

The central and strongest feature of the system is the San Pedro vein, striking N.W., with strong concavity toward the north and dipping north 40-45 deg. This vein cuts across the whole system, and seems to divide the north from the south veins. Probably it is a fault, but Professor Arenas' map does not show veins that stop at the San Pedro. This vein has a well marked hanging, but no foot near the surface. The map fails to indicate the innumerable ramaleos, or little irregular stringers, which are especially abundant near the veins. According to the old records they are abundant 1000 ft. deep and within 100 ft. of the outcrop they have permitted impregnation of the foot for a thickness of 160 ft. under the San Pedro and quarries of this width have been opened in the ore there. These quarries are practically continuous, covering 875 ft. in a total length of 1050 ft. They have supplied the hacienda with more than 300,000 tons of ore. There is a long tunnel 275 ft. under the outcrop in which the San Pedro vein is 57 ft. thick.

Occurrence of "Ramaleos."

The other veins run from 1 to 8 ft. thick and are very persistent in length. As to the ramaleos, the Veta Principal, is a good illustration of the conception which Profesor Arenas formed of the constitution of these veins. In addition to several veins it shows some bodies of ramaleos, and the old records mention some of these as being very rich. I do not believe these are mere fancy sketches. The hill is so honeycombed with openings that Arenas probably had excellent opportunities for observation. He wrote a description of Proaño, which discussed its physical and geological feature, and its vein system. We have the two former parts but the third is lost.

I confess I do not know which of the veins he depicts in this "veta principal." It cannot be the San Pedro, which is the most important of all for that dips north and the "principal" southwest. I suppose it will have to be classed as shearing, but the term is not descriptive. Here is a mass of rock which has been explored for half a mile square and found to contain several complexes or fractures.

The crushing has produced not only the long and nearly parallel lines, but wide short bunches of small cracks which are as limited vertically as they are horizontally. What directed this concentration of effect upon these spots is an interesting question. Shearing with movement ought to distribute the effects somewhat equally through the mass but these ramaleos look as if the rock fragment had been held firmly in place while it was splintered.

Absence of Marked Faulting.

It is plain from this sketch that Profesor Arenas did not discover marked faulting, for I am convinced that this is a map made from measurements, and not a fancy sketch except as to the ramaleos, which are beyond the reach of accurate surveying. The crossing vein could not be drawn as they are if they faulted each other.

Auld and Buchan, English engineers, who examined the mines when the State sought the aid of English capital in 1834 say "more than 50 perfectly distinct" veins have been found, and that the dip at the surface was 70 to 80 deg., but lessening with depth. Even then the workings were very large for they say: "In fact there can be no other mines in Mexico which present such strong evidence of large production in the past.

The Cerro (hill) is perforated in every direction and formed its interior" (referring to the dumps). There are 35 shafts on the hill, and the openings underground must be very extensive.

These interesting mines have been taken over by Philadelphia parties, and their development will be worth watching. While the vein formation is somewhat like that of La Luz, in having its origin in ramaleos, there is a marked difference in the abundance of quartz filling in one and the almost entire absence of it in the other case.

Dissolved Air in Cyanidation and Flotation.[*]

The whole subject of flotation depends upon gas absorption. The mineral to be saved as a concentrate must have occluded sufficient gas to prevent its being wetted by the flotation liquid. Once wetted with the flotation liquid, its tendency is to sink as there can then be no surface tension effect tending to float it. The flotation liquid may be assumed in all cases to be water as it has been proven that no liquid except mercury has such great surface tension. Water will enter the pores of a solid from which all gas has been driven out and adhere to the surface so that the solid becomes as a part of the liquid so far as surface tension effects are concerned. That is, if there is a force of adhesion existing between the molecules of the water and the molecules of the solid, flotation cannot take place. If the particles be on the surface of the water, this truth is readily seen when an attempt is made to float them with say a Henry Wood type of machine, but it is not so readily seen when an attempt is made to float them by means of bubbles or froth if the particles be below the surface of the water.

Hereinafter then, only flotation of submerged particles will be considered. If a particle is to be floated by means of minute bubbles, these bubbles must be attached to the particle; or, if it is to be floated by means of froth, the particle must be attached to a bubble. The surface tension of a liquid film surrounding a gas buble, being much greater than the adhesive force between a gas and a solid, holds the gas firmly inside the film so that attachment in this case between the gas and solid cannot take place. It is easily proven that gas, to be attached to a solid in a liquid, must be in a nascent state in the liquid. On being driven out, it will collect in the form of bubbles. It is therefore quite evident that, if the solid contain some of this gas, it will be a nucleus for the collection of these bubbles due to cohesive force existing between molecules of gas at the surface of the solid and molecules of gas in the liquid immediately surrounding the solid. Since air is readily soluble in water (especially the oxygen) and also since it is occluded by most solids, due especially to the chemical affinity of the oxygen, it is by far the most preferable gas for flotation as well as the cheapest, and will be hereafter the only one considered.

Due to the fact that air is soluble in oil and that oil is practically insoluble in water, it is readily seen that gas can be much easier attached to oiled mineral particles. Molecular attraction only being considered, the thinnest possible film of oil is all that is necessary. "Oil prevents the wetting of mineral particles" is evidently an erroneous statement since it is common practice to oil-coat the mineral particles while they are in the water. The particle contains gas and therefore can be oiled. Due to the cohesive force of the oil, a film may be formed which adds strength to the water film and prevents the bubbles from bursting so easily.

By the addition of an acid or an alkali to the water to form an electrolyte, an ionized condition is produced which creates a selective action of flotation due to occlusive power of at least some of the minerals being affected.

Role of Air in Flotation.

After examination of all the different materials used in connection with flotation, it is seen to depend entirely on, first, dissolving air in preferably an electrolyte as well as in the ore and, second, the expulsion of this air. This all depends on Henry's law. From this law it is readily seen that air may easily be expelled from either the electrolyte or ore particles by heat or reduction of pressure.

It is evident that it makes no difference whether the gas be absorbed at high pressure and liberated by reduction to atmospheric pressure or absorbed at atmospheric pressure and liberated by vacuum. Naturally then the fundamental requisite for flotation is the production of a state whereby both water and mineral will absorb air. This eliminates any process in which air, dissolved at atmospheric pressure and temperature, is liberated by a vacuum, as such a process, necessarily limited to low altitudes, is crude and full of too many mechanical difficulties which make it unnecessarily expensive to operate. This has been the experience of plants operating by such a method.

According to the law of Henry, it would be possible, by varying temperature and pressure, to make water absorb its own volume of air since, for instance, at 10 deg. C. it is known to dissolve $2^1/_3$ per cent of its own volume at sea level. As an example, it would be quite easy to subject the water to say 90 lb. pressure per square inch or six atmospheres when, at the ordinary mill water temperatures of 10 deg. C., it would dissolve 15 per cent of its volume of air. As this requires some power, it is well to investigate the quantity necessary to be dissolved to effect flotation. That is, what degree of saturation is necessary?

As noted above, it is only the air that is driven out of solution or nascent air that can be used for bubble making or flotation. These bubbles ,on coming to the surface, tend to burst, due to expansion, etc. Then the greater the pressure of the gas in the bubble the greater will be this bursting tendency. Therefore it would seem desirable to from these bubbles at comparative shallow depths in the water and with as little pressure as possible. In other words, mere supersaturation of the water with air near the water surface.

Supersaturating Liquids with Gases.

A simple way to supersaturate water with air at atmospheric pressure is to beat it in with paddles or stirrers. The Minerals Separation Co. has patents describing this means. "Beating air into solution" does not well explain just what action takes place. To study this, take the simplest case of a single paddle, say a piece of wood partly submerged in water. Move it

[*]Abstract of an article in Metallurgical and Chemical Engineering by C. Terry du Rell.

rapidly through the water. The instant the water is divided, a film of air forms on these division walls. As the water closes in again behind the paddle, this air film is taken into the interior of the water. Being a mere film, it is absorbed. The water, being already saturated with air, cannot hold any more so the excess must come out in the form of bubbles.

If there be paddles or blades on a shaft revolving rapidly below the surface of the water, a vortex is created and the water, on going down to take the place of that thrown out from the ends of the blades, carries air in with it as a film on the surface. It is readily seen that surface tension is the cause of this air being carried in and absorbed by the water. If the bubbles form fast enough, froth is produced, especially if there be sufficient material present to coat and toughen the bubbles.

This is a common method for getting air into solution and of every day occurence. Eggs are beaten to a froth and the bubbles toughened with sugar. A small boy drags a stick rapidly through the water to see the bubbles in its wake. The water astern from a ship is white with the reflection of light from the air bubbles of supersaturation caused by the propeller. The surface tension at the crest of a wave, on "breaking," causes the air to be absorbed and given out as bubbles.

Another way of supersaturating a liquid with a gas has hitherto not been taken advantage of in flotation. Common occurrences of this are to noted as well. On drawing water from a tap into a wash basin for instance, bubbles are seen to form and rise to the surface. Where does this air come from? If water from a hose be turned by means of a nozzle into a bucket some little distance away, a froth is formed. Fish in an aquarium rise to the surface for want of air. The attendant opens a jet of water fixed a short distance above the surface. This water shoots down into the aquarium, a stream of bubbles rise to the surface and the fish goes back to the bottom satisfied.

A stream of pulp is turned into a thickening tank from some little distance above, either directly or through a pipe straight down and below the surface and the millman is driven distracted by the froth that forms and causes a muddly overflow. It is then necessary to fit an interior ring as a barrier against the bubbles in order to obtain a clear overflow.

These phenomena are therefore worthy of investigation as air can apparently be taken into solution this way as well as with paddles or stirrers. This may be classified and defined as streams of liquid projected through a gas and into a liquid. The term liquid jet is applicable as it is a phenomenon of a jet of liquid as shown by the cited examples.

Phenomena of Liquid Jets.

In investigating this, it would be well to first investigate the injection of a liquid into a gas. The liquid may be injected (1) vertically upward, (2) vertically downward or (3) at an angle. With a jet turned straight down, gravity is bound to accelerate the fall of the liquid. At some distance from the nozzle, the liquid will be traveling faster than that portion leaving the nozzle, due to this acceleration. This, it is seen, will tend to break the stream up into short cylinders and stretch the intervening liquid into long thin cylinders. Further acceleration will break these larger portions off. Surface tension, having rounded the edges previous to their breaking off, will immediately form them into drops and at the same time form smaller drops from the long thin cylinders in between. Thus there will be a falling succession of drops alternating large and small. The surface tension of the air film is so great that these small spheres are formed. Pictures have been taken showing this action in detail.

With the jet turned straight up, gravity retards the stream so the velocity becomes less as the distance from the nozzle increases. The whole stream is surrounded as before with an air film, the surface tension of which carriers it along. When the gravity plus the weight becomes equal to the initial pressure, portions must be forced out sideways and spherical drops formed as described above. The surface tension of the surrounding air films prevent their re-uniting so that they will actually rebound from one another.

With a jet turned out at an angle (horizontal or inclined), gravity retards and pulls the stream down until portions are broken off to form spherical drops. The viscosity of a liquid tends to counteract this so that glass, for instance, can be spun or drawn out into threads.

The intensity of this surface tension effect may be shown by directing a jet of water onto an oiled or dusted surface when the globules of water will be held intact and roll the same as if they were enclosed in a solid substance when, in reality, they are only enclosed in a "skin of air."

The jet of liquid before breaking up was thus seen to be enclosed in a cylinder of gas, the surface tension of wich caused it to move with the liquid and at the same velocity. The rush of air into a large nozzle to form this enclosing air cylinder may be readily felt by the hand. In other words, a jet of liquid turned into a gas does not merely slide through that gas or cylinder of that gas but carries the "gas cylinder" along with it.

If the jet of liquid, passing through a gas, be turned into the surface of a liquid, the enclosing gas cylinder is evidently carried into the liquid and, if the liquids mix or are soluble in each other, the gas must be liberated. That is, the cohesion or adhesion, as the case may be, of the liquid jet for the liquid it has penetrated is sufficient to overcome the surface tension of the gas cylinder. The gas, being in such a thin film, is so finely divided it enters in between the molecules of the liquid in the intersticial spaces, and, if the liquid is not already saturated, remains there. A jet of gas entering a liquid, would, due to this surface tension effect, act the same as a jet of liquid entering a gas.

A simple way to prove that this gas cylinder goes into solution is to turn a jet of water into a vessel of water that has been boiled and cooled. On reheating, air will be expelled from the water in this vessel while none will be expelled from a similar quantity of water into which no jet has been turned.

When a liquid is entirely saturated with a gas brought in with a jet, supersaturation has the effect of producing nascent gas which collects in the form of bubbles. This fact is taken advantage of for flotation and will eventually be put to many other uses.

At the present time, this principle is used to a large extent for the hydraulic compression of air, where the surface tension causes the air film to be entrained and carried down a pipe or shaft to be liberated at the bottom in a chamber under pressure. Frizell, although not recognizing this principle of air introduction with his air compressor design, does recognize the fact that it is not necessary to have a large number of small air inlet pipes at the intake. The simplest form is used for ventilating mines and, since oxygen is more soluble in water than nitrogen, the liberated air contains nearly 35 per cent oxygen against less than 21 per cent oxygen in the air introduced by a blower, for instance.

Importance in Cyanidation.

It seems strange that this liquid-jet phenomenon has not been recognized before by may cyanide metallurgists since it has been the direct cause of many cyanide

plant failures. Visit any old or modern cyanide plant and see the numerous jets of solution passing through the air and into a tank of solution. Pumps deliver streams here and there and through the air into tanks of solution or of pulp. Everything is supersaturated with air.

With sand leaching, this does not prevent operations being carried on, although, with some ores, an extra cyanide and lime consumption results. The millman simply remarks that the ore has a latent acidity, dumps in more cyanide and lime and lets it go a that. He does not bother with a reason for certain contained minerals being rapidly oxidized.

However, it is with the slime that big troubles occur. When the slime is very fine, and settlement and filtration difficulties are experienced, the millman, knowing it is not a crystalloidal slime, assumes that it must be a colloidal slime and that settles the question though not the slime. Simple logic this. It must be one of two thing. Therefore, since it is not the one must be the other. The last few years, many cyanide metallurgists seem to think only of "the gel state" or "the sol state" and seem to have forgotten that a state of suspension can exist so that a pulp may only resemble a colloidal state.

This excess air coming out of solution is attached to even the smallest particles of slime as well as the larger particles. The larger ones can perhaps settle in spite of this buoyant tendency while the smaller ones may not show the slightest tendency to settle. It is a well known fact that settlement of the particles or of a precipitate takes place rapidly after the solution has been boiled and cooled. The only effect of the boiling is to drive out the air.

In many cases, when a solution of water stands until it appears perfectly clear, boiling and cooling will show an appreciable sediment on the bottom of the container.

It is certainly extremely difficult to thoroughly mix a pulp ready for filtration when some of it is floating, due to air bbubles, and the balance settles out readily. Much trouble is thus caused with the cake on a vacuum machine as well as in a press.

Plenty of trouble is caused in a cyanide plant when the bubbles are practically microscopic but great difficulty has been experienced at some plants where the bubbles were quite large and at a few where froth formed.

It seems doubtful if there is a single case of difficult slime settlement due entirely to a true colloidal condition as most pulp solutions are so supersaturated with air that they are more nearly ready for a flotation plant than they are for a cyanide plant.

The Rill System of Stoping and Filling.

By Roberto Allen.

The following brief description of the "Rill System" of stoping was recently presented by the author before the Chemical, Metallurgical and Mining Society of South Africa. This system is largely used in Australia and will no doubt prove of interest to many of the mine managers of Mexico.

When working under ideal conditions, the orebody, if continuous, is divided into blocks by equidistant levels, about 200 feet apart, and by equidistant winzes on the hanging wall side of the lode at about from 150 to 200 feet apart. The reason for having the winzes on the hanging wall side is that the stopes are thus filled with the least amount of handling.

The filling usually consists of fresh residue, which may be of sand, or of roasted "slimed" ore, and which may contain up to 25 per cent of moisture. If the residue contains too much moisture there is a danger of its clogging the passages, so that sometimes it is necessary to stack it on the surface for a short time previous to delivery to the mine, and by this means also much of its residual cyanide content is destroyed. No chemical treatment whatever of the residue to destroy its cyanide contents is practiced. The residue received from the surface can be distributed to the various winzes by means of a belt conveyer system along a disused level along the topmost workings.

The method of stoping and filling on the rill system is as follows: On any particular level a leading stope is taken out below the ore to be mined, when the drive is timbered usually, either by single stulls, or when the lode is over fourteen feet wide, by saddle backs at intervals of five feet. The latter consist of pairs of stulls sloping towards one another like the rafters of a roof and bearing upon a longitudinal ridging of sawn timber 2 inches thick. The stulls are lagged with poles about 4 inches in diameter of a local wood called gimlet wood, or with old iron pipes. The lagging is in turn covered with old filter cloths, or the sides and lining of cyanide cases or any other inexpensive material which serves to prevent the residue from falling through.

Two alternative methods of stoping the ore are followed in removing the ore. In the former all of the holes are down holes and can be drilled wet, which is an important consideration in view of the necessity of reducing dust production. In this method the benches are taken out in a inclination slightly flater than that of the natural slope of the filling which in the case of residues is about 45 degrees.
This is the more commonly used method.

In the alternate method the ore is mined by a series of horizontal cuts, and some of the holes drilled must be uppers and drilled dry.

Usually during the timbering of a drive ore chutes are put in at distances of 50 feet, one midway between the winzes the others being intermediate. As stoping proceeds, passes about 4×4 feet in the clear are built above these chutes, usually of 7 inch logs, but sometimes 9×3 inch sawn timber. Each winze is also cribbed up except where it will not be required later on for passing "filling" to lower workings or for ventilation. In such a case the timbering of the level below the winze would be closed up and the winze filled up.

The breaking of the ore and the filling of the stopes with residues succeed one another alternately. Before the benches of ore are blasted saplings or slabs are laid on the sloping surface of the residue filling. These serve to keep separate to a great extent the broken ore from the residue, and assist in its "rilling" into the passes, very little labor being then required. The passes are then built up close to the working faces and covered over to prevent residues from entering them and the poles or slabs are removed. More residue is then dumped down the winzes into the stopes, filling them up to a convenient distance from the faces. As stoping proceeds it is usual to stope a series of blocks on the same level simultaneously, so that the filling of the stopes with residue on both sides of the winzes and the building up of the passes can be carried on symmertically. When the stopes are nearly beaten out it is usual to sink subsidiary winzes in the triangular blocks of ore left below the level above, through which the residues for filling can be dropped. The lodes in Western Australia are usually very steep, and rill system of stoping and filling is particularly applicable to them. Generally as the dip of the lodes decreases below 45 degrees, more and more shoveling is necessary to assist the rilling, and the method becomes inapplicable when the dip is less than 35 degrees.

Recent Progress in Flotation.

The flotation process is attracting wide attention in metallurgical circles in the United States, and a large amount of experimental and research work is being carried out. A summary of some recent developments is given hereunder:—

Fine Crushing for Flotation.—The most interesting feature in this connection is the success of the Marcy ball mill. There seems a possibility of improved machines of this type replacing other crushing machines for reducing crude ore from 1½ in. mesh downwards.

Flotation of Copper Ores.—The most recent developments are along the lines of the Callow process, aiming at a reduction of mechanical agitation and its attendant maintenance costs.

Two main features in these latest methods are, firstly, a preliminary mixing of the medium with the crude ore, and secondly, aeration by means of complete atomisation of compressed air. The principles involved are briefly these. The sulphide particles are first of all coated by an oil envelope, whether directly or per medium of an air space one cannot say. These particles of sulphide minerals with their oil envelope are then buoyed up by infinitesimal bubbles of air to the surface of the pulp and floated away from the remaining gangue particles. The preliminary mixing is done in particular cases by means of compressed air in Pachuca tanks, but the latest practice is to add the medium to the crude ore pulp in its passage through the crushing machinery, thereby utilising to the full extent the agitation from tube mills, elevators and other moving parts. The atomisation of the air is effected by means of passing low pressure air through layers of canvas twill or porous media, such as carborundum, and thence into the pulp.

An interesting fact in connection with these methods is that once the complete mixing of medium and crude ore is effected, the sulphide particles can be aerated and buoyed up out of the solution without any mechanical agitation other that that caused by the atomised air passing through the pulp.

The Parral agitation process endeavours to perform the two foregoing stages in one step, by compressed air; whether with success or not cannot be stated with the present information to hand.

Developments are also taking place in the Minerals Separation methods, along the lines of agitation with compressed air at low pressure.

All these developments are of especial interest in view of the patent litigation in America between the Minerals Separation and other campanies.

The Callow Process.

The following description of the Callow process, abstracted from an interesting letter by Mr. Callow, in the "Mining and Scientific Press," May 29, 1915, clearly illustrates the present lines of improvement in flotation methods:—

"The various elements that compose the scheme in general are illustrated in the accompanying diagram. The preparation of the pulp by any form of violent or propellor agitation is not necessary for good results with the pneumatic process. Where the oil can be introduced into the tube mill no further refinement in mixing is necessary. This, of course, cannot always be done, and in such cases air mixing with the Pachuca becomes necessary.

"A standard separatory cell has a capacity that will vary from 35 to 75 tons of feed per 24 hours when run in parallel depending of course upon the characteristics of the feed. The cells in parallel will have about the same capacity as two cells in series, but a slightly lower tailing may be expected with the series treatment.

"The porous medium in the bottom of the cell is a loosely woven canvas twill, four layers thick, secured to the upper surface of a perforated plate with bifurcated rivets and washers. This is the present standard construction, and has been adopted after a great many disappointing experiments with other materials. It is good for three or four months' contiuous campaign, and becomes inoperative only through the filling up of the pores by dust that has been introduced by way of the blower. Four or five pounds of air pressure is ample in all cases to give the proper aeration, the quantity of air varying from 6 to 10 cu. ft. per square foot of blanket surface. When the cell is properly adjusted and doing its best work, there should be no violent agitation within the cell, but only such agitation as is incident to proper aeration. Any violent agitation producing a surging of the liquid contents has proved detrimental to good results.

"A slope of 3 in. per foot on the bottom has been found sufficient to treat all ordinary ores after crushing through 30 or 40 mesh. Treating coarse material or ores that contain a large percentage of heavy gangue (such as in the Coeur d'Alene), it has been found advantageous to increase this to as much as 4½ in. per foot, to prevent the blanketing of the porous medium by coarse sand collecting on the bottom.

"The air for the separatory cells has so far been furnished from positive blowers, but turbine blowers would be preferable where the size of the installation justifies their adoption. An air-pressure of 15 lb. is ample for the Pachuca mixer, and 25 cu. ft. of free air per minute is sufficient volume for mixing 250 tons of minus 84-mesh pulp, and of course should be furnished from a low pressure compressor.

"The density of the pulp may vary from 2½:1 on a sandy feed, up to 7:1 on a strictly slime feed. The particular density is not a matter of so much importance as that the supply of pulp shall be uniform as to its density, since each variation in the density requires a readjustment of the oil supply, the quantity of oil required increasing in proportion to the increased volume of the pulp independent of its solid content.

"The advantages of the pneumatic scheme are greater recoveries, less oil, greater simplicity, and less skill required to operate. The difference in wear and tear is obvious."

The method of retreatment of concentrates produced from a roughing machine or series of machines, and returning the residue therefrom to the main feed supply, is not new, as it has been in use for years in Broken Hill plants, and may be said to be a standard method of treatment there.

The oils used in the treatment of copper ores in America are mixtures of heavy oil and light frothing oils. The advantages of mixing oils in this way has long been recognised in Australia, and the success of the Callow process has to a large extent been due to the exact information obtained on the properties of

*Fron the Mining and Engineering Review.

frothing agents and frothing oil by the continued research of the Minerals Separation Co.

Preferential Flotation.

Recent American literature on this subject indicates very plainly that, as in past years on ordinary selective flotation, so now in preferential flotation American metallurgists are simply developing Australian ideas. At the present time any patents of practical use to preferential flotation are in the names of Australian metallurgists. Preferential flotation of galena from sphalerite in Broken Hill has long ago passed the experimental stage. Both slime from freshly crushed ore and slime from the dump, which for years baffled metallurgists, have at last been successfully treated on a large scale. In the treatment of mixed lead and zinc slime concentrates at the Zinc Corporation plant, the Horwood process has proved to be a very payable proposition, and the costs of treatment were found to be much lower than was estimated from original laboratory tests.

An interesting article by O. C. Ralston on this subject in the "Mining and Scientific Press," June 26, 1915, reviews various processes in connection with preferential flotation.

Mr. Ralston first refers to Cattermole's process, and concludes with the remark that "it is not impossible that its principles may be applied to modern flotation froths." In the light of modern knowledge on this subject, however, one must dismiss as worthless the old patents of Cattermole, which, to say the least, were merely speculative.

In commenting upon the various patents, Mr. Ralston makes statements which are not borne out by facts. The Lyster process, for instance, has given excellent results in Broken Hill. Lyster was the first metallurgist to apply the essential factors necessary in preferential flotation. Very little oil is used, and the extraction on the classes of material for which the process is suitable is very high. The underlying principles of this process, which depends on the application of intense aeration to preferential flotation, are apparently unknown to Mr. Ralston.

In the patent of Greenway and Lowry reference is made to the effect of potassium bichromate in oxidising the surface of galena particles to lead sulphate. This can hardly be the case when potassium permanganate, which has been successfully used for preferential flotation of lead from zinc has an entirely opposite effect. Sulphide particles can be prevented from floating or deadened by agents whose chemical action on them, taking into consideration the strength of the solution used, must be very slight. For instance, sulphuric acid used under certain conditions produces a preferential flotation of lead sulphide from zinc sulphide, but if these conditions are only modified in a slight degree, both sulphides float collectively.

Recent developments in Broken Hill have been in connection with reagents, which temporarily prevent ore sulphide from being floated, either by causing it to be wetted or by some other physical action. Lead sulphide may be preferentially floated from zinc sulphide, and the zinc sulphide afterwards floated with high grade products in each case, or the process may be reversed. The underlying principles of preferential flotation are not fully understood, but they can be readily controlled and the time is not far distant when several sulphide minerals in a complex ore will be differentially floated in succession on a large scale profitably.

Alloys in Engineering Construction.

Among the more important materials of construction are alloys usually differing in properties from the metals from which they are made. The most extensively employed alloys are those of which copper is the base. In these copper is mixed with zinc to make brass or with tin to make bronze. Both brass and bronze have been used from remote antiquity. Brasses cover a range of from 55 per cent copper and 45 per cent zinc to pure copper. The alloys containing from 63 to 70 per cent copper are known as 'high brass.' These especially combine strength, uniformity, toughness, and ability to withstand manipulation. They are not capable of being worked hot, but are used in sheets and strips, seamless tubes and wire. The value of these 'high brasses' is due to their resistance to corrosion, and ability to withstand forming operations.

Muntz metal contains between 55 and 63 per cent of copper with 45 to 37 per cent zinc; it is strong, relatively cheap, and can be worked hot. Seamless tubes of Muntz metal are made by the Mannesmann process, by which solid cylindrical billets are pierced by hot rolling and subsequently finished by cold drawing. Lead, up to 3 or 4 per cent is added to Muntz metal, forming a mixture that can be easily machined at very high cutting-speeds and can, at the same time, be readily extruded. For purposes where great strength is essential, Muntz metal is alloyed with as much as 1½ per cent tin, or tin and iron. The former mixture is the rolled bronze of the U. S. Navy, while the latter constitutes manganese-bronze.

Alloys containing about 80 per cent of copper are called 'low brass'; with 90 per cent of copper, 'commercial bronze'; while those with 95 per cent of copper are termed 'gilding.' The bronzes are next in importance to the brasses; they consist of copper alloyed with tin. In the production of satisfactory bronzes it is necessary to use a flux; phosphorus is usually employed, forming phosphor-bronze. This material has an extensive application where hardness, strength, and reliability are required. Red brass is a term applied to alloys of copper, zinc, lead, and tin; a very wide range of strength, toughness, color, cost, and machining qualities may be obtained. The copper ranges from 76 to 87 per cent, lead from 3 to 6 per cent, tin from 2 to 7 per cent, and zinc from 3 to 16 per cent.

A standard mixture for bearings when heavy pressures are to be met is 80 per cent copper, 10 per cent tin, and 10 per cent lead; phosphorus is used as the flux. Aluminum-bronze contains a maximum of 10 per cent aluminum; the strength increases with the increase of aluminum, but the ductility decreases with the highest strength of 85,000 lb. per square inch. Nickel and copper readily alloy and yield products having useful qualities, but are expensive. Monel metal is a natural alloy in that the copper and nickel are mixed in the ore from which it is made; it contains 68 per cent nickel, 2 per cent iron, 30 per cent copper, and has a tensile strength of 65,000 lb. per square inch.

* Abstract of a paper by W. Reuben Webster, read at the International Engineering Congress, San Francisco, September 22, 1915.

Heretofore Peru has obtained Portland cement entirely from abroad, large quantities being purchased in the United States, England, and Belgium; but recently a company has been formed in Lima to undertake the manufacture of cement. Suitable material is said to be plentiful.

Hydro-Electrolytic Treatment of Copper Ores.[*]

By R. R. Goodrich.

The following is a summary of the results obtained from research work on a porphyry copper ore from Bisbee:—

It was desired to select an Arizona problem, so the treatment of a porphyry copper ore seemed to be one of the most important. This kind of ore when treated for the extraction of its copper by mechanical concentration and smelting, the methods most generally employed, yields 66 per cent. or less of its copper.

In these experiments, therefore, the aim was to determine a better method of treatment. The method selected for investigation was one in which metallurgists are at present doing much experimenting in the hope of demonstrating the superiority of leaching and electrolytic precipitation over earlier practice—namely: (1) Oxidising roast; (2) leaching with dilute sulphuric acid; (3) electrolytic precipitation of the dissolved copper.

While it was planned to carry on a complete systematic test of the ore thereby enabling one to determine the suitability of this ore to the hydro-electrolytic treatment, special stress was laid on roasting and on electrolytic precipitation using sulphur dioxide to lessen the consumption of power and to produce additional sulphuric acid.

It has been demonstrated in these experiments that it is feasible to roast successfully the ore, so that when leached with hot dilute sulphuric acid, the entire copper contents may be obtained in solution.

Some of the practical engineers say that they secure but little beneficial reduction in power consumption when using sulphur dioxide gas as a depolarizer. Tossizza says: "I have thought to use.....insoluble anodes kept in contact with sulphurous acid ,and thus to utilise the known depolarisation properties of the said sulphurous acid. These anodes can be made of carbon, and in this case the sulphurous acid can be introduced outside the anode or in the interior thereof"; "One can thus obtain a very beautiful deposit of pure electrolytic copper.....with a sufficient intensity at a voltage of about six-tenths of a volt." The experiments reported under Tests Nos. 3 and 4 corroborate Tossizza's statement in that the method of introducing the sulphur dioxide into the electrolytic is unimportant, provided only that it be introduced in sufficient quantity to keep the electrolyte saturated.

Regarding the saving of power (depolarisation), these experiments show depolarisation by the use of sulphur dioxide only when used in connexion with carbor anode; while Tossizza, although specifically suggesting a carbon anode, intimates that the same may be obtained with other insoluble anodes. Tossizza does not state the current density at which he was operating when depositing copper with the extremely low voltage of six-tenths of a volt, although "with a sufficient intensity" might mean commercial current density. Experiment shows, likewise, that copper deposits continuously at six-tenths of a volt when current density equal 5.8 amperes per square foot, depositing 4 lbs. of copper per kilowatt-hour. It is to be noted that although beneficial depolarisation and consequent saving of power is secured at all current densities, when SO_2 is introduced into the electrolyte, it is relatively not the same in amount but decreases as the current density increases.

It is to be hoped that future experiments will demonstrate how to secure the same beneficial depolarisation with sulphur dioxide when electrolysing with high current densities. Likewise whether, and how, beneficial depolarisation by sulphur dioxide may be secured with other kinds and types of insoluble anodes.

When it is desired to extract the copper from the electrolyte down to a small trace, sulphur dioxide is very beneficial, not only in reducing the power consumption but in causing the copper to deposit more firmly on the cathode, which, when sulphur dioxide gas is not used, forms as a spongy deposits toward the last of the electrolysis. On attempting to extract the last trace of copper from the electrolyte, sulphide of copper forms on the cathode.

Regarding the lead anodes, there is no depolarisation when used with or without sulphur dioxide gas. There was no loss in their weight during the test.

When starting out on this line of investigation, it was found necessary to design and construct a complete plant on a miniature scale. In doing this, a novel idea appeared—the step arrangement—which greatly facilitated the work in all stages of the process, especially in the finishing step, where the copper was extracted down to a trace with the production of a good firm cathode, when sulphur dioxide gas was used.

Tests demonstrate, when using the step system, the feasibility of depositing copper continuously from the electrolyte, while at the same time the copper contents of said electrolyte remains undiminished. A plant composed of several steps of such cells may be operated so that a liquor strong in copper flows into the upper step of the plant continuously from the leaching vats at such a rate that a liquor depleted of its copper, in which the acid solvent has been regenerated, outflows from the plant continously to the leaching plant. The advantages of a step arrangement of plant are apparent in that the electrolysis is conducted under constant invariable conditions in each cell of the respectice steps, as well as in every part of the cell. The cathode area of a step may easily be adjusted so that the most desirable current density is secured (as determined by experience in operating). It is to be noted in step arrangement of plant, the electrolyte may be circulated in any of the steps at any desired rate. This has been shown to be beneficial in promoting high current efficiency

The experiments demonstrate that the porphyry ore, when treated by a hydro-electrolytic process, will yield its entire copper contents as a good grade of cathode copper. It is, therefore, hoped that by using a hydro-electrolytic method, lower-grade copper porphyry deposits may be worked than formerly could be worked by methods of concentration followed by smelting.

Epitome.

1. The most suitable temperature for roasting the Arizona porphyry copper ore, containing sulphides, in order to render it amenable to acid leaching methods, is between 600 degs. C. and 725 degs. C. The more finely-ground the material the shorter the time required for the roasting so as to produce the maximum

[*]Summary of a paper read before the American Institute of Mining Engineers.

amount of soluble copper: materials which will pass through a 20-mesh screen and remain on 80 mesh require about two hours roasting at 600 degs. C. to 725 degs. C.; and when ground to pass through an 80-mesh screen the time required is about one and a-quarter hours. If the roasting is concluded at temperatures above 800 degs. C., the oxidised copper is converted into a compound which is insoluble in dilute sulphuric acid. The longer the roasting is conducted above 800 degs. C., the greater the amount of insoluble copper produced.

2. A heated solution is necessary to leach efficiently the copper from the roasted material. A 10 per cent. H_2SO_4 solution at 100 degs. C. leached out, in from three to six hours, all the copper from all roasted materials (through 40 on 80 mesh, through 80 mesh, whole through 20 mesh), except material through 20 on 40 mesh, in which case the extraction was not so high.

3. The nature of the anode is an important factor in securing depolarisation by sulphur dioxide gas.

4. Depolarisation with consequent saving in power is accomplihed when using sulphur dioxide gas with a carbon anode, while there is no depolarisation with a lead anode.

5. The depolarisation by sulphur dioxide gas, even with carbon anodes, does not reach the theoretical amount, being between between 45 and 65 per cent.

6. The amount of depolarisation effected by sulphur dioxide gas when used with carbon anodes varies with the current density, being a maximum at low current density.

7. The method of introducing the sulphur dioxide gas into the cell is unimportant. All that is necessary is that it be introduced in some way, and in such quantity that the electrolyte is saturated with the gas, so that there is some escaping by bubbling at the surface.

8. A smoother deposit of copper forms when using sulphur dioxide gas as a depolariser than when not using it.

9. In the electrolysis of an acid solution of copper sulphate, when sulphur dioxide is not supplied to the cell and when one is endeavouring to carry electrolysis to the point of complete extraction, a soft spongy deposit begins to form on the cathode before the complete extraction of the copper is effected. There is also a considerable rise in polarisation when the copper contents of the electrolyte becomes low.

10. In the electrolysis of an acid solution of copper sulphate, when sulphur dioxide is supplied to the cell, the copper contents of the electrolyte may be reduced to a very small trace with the formation of a good, firm cathode, without rise in polarisation toward the end. Current density and energy efficiency remain high to the end. It is only when prolonging the operation beyond the time when but a small trace of copper remains that sulphide of copper forms as a thin coating on the cathode.

11. Lead anodes do not peroxidise or deteriorate appreciably when used with or without the introduction of sulphur dioxide into the electrolyte.

12. A novel idea—step arrangement of process—makes feasible the depositing of copper continuously, while the copper contents of said electrolyte in the respective steps remains constant. A plant composed of several steps of such cells may be operated so that a liquor strong in copper flows to the plant continuously, and the liquor which out-flows from the plant is depleted of its copper.

13. The circulation of the electrolyte by the step arrangement increases the current efficiency. Such rapid circulation is not possible in plants as ordinarily arranged.

Wells More than a Mile Deep.

The deepest well in the world is in Upper Silesia, in the German Empire. It is a diamond-drill hole in a coal field and is 7,350 feet deep. A well in the United States which may go deeper, according to the United States Geological Survey, is 4 miles northwest of Mc Donald, Pa., and about 15 miles west of Pitsburgh. This well, which is being sunk to the Medina sandstone—a bed that elsewhere contains oil and gas—is now 7,174 feet deep. Some gas and oil were struck in the upper part of the well. Between the depths of 6,830 and 7,100 feet rocks bearing rock salt and salt water were encountered. These are regarded as of Salina age, the same as those carrying rock salt in western New York. The temperature in this well at the depth of 6,775 feet, as recently determined with great accuracy, is 145.8 degres Fahrenheit.

At Derrick City, McKean Country, Pa., near Bradford, there is a well 5,820 feet deep, which is probably the second deepest well in the United States. Another deep well is on Slaughter Creek, Kanawha Country, W. Va.; it is 5,595 feet deep. It penetrated a sandstone at 5,030 to 5,050 feet, and from this depth to the bottom, a distance of 545 feet, the well is in limestone. Near West Elizabeth, Pa., there is another well 5,575 feet beneath the surface, penetrating into a black shale. Another deep well is being drilled at Gaines, Pa. This has already reached a depth of 5,500 feet. Deep well drillers in this country of course employ the most improved and effective rigs, but one of the most remarkable of wells, reaching a depth of 3,600 feet, was drilled for petroleum in western China by means of such crude appliances as a cable made of twisted strands of rattan.

Effect of Alkali Waters on Portland Cement in Concrete.

By Frederick W. Foote. *

A study of alkali waters and their effect on the tensile strength of cement, when used in its mixing, should be of interest to the readers of the Mexican Mining Journal, I been present the results of a series of test performed by N. M. McNeill of the Colorado School of Mines, to determine the point above which any additional alkali would cause a decrease in the tensile strength of the concrete.

Nowadays in building concrete structures for dams, reservoirs and allied uses, it is a question of using the alkali saturated waters which are characteristic of the arid regions of Western America and Mexico, or using water of a lower percentage of alkali. In deciding this question one must balance the cost of hauling water from some distant source or boring deep wells, against that of using the water at hand and risking its deteriorating effect.

The substance most prominent in the natural occuring alkali waters of the West are sodium carbonate, sodium sulphate and gypsum. I made up solutions of the above alkalies of the following strengths:

Parts per 1000 water sodium carbonate varied, 36 briquets and a saturated solution of gypsum and 12 briquets of neat cement to be tested at the end of six months.

These briquets were subjected to two conditions: namely that of the moist chamber, which was merely a zinc lined box the inside of which was lined with burlap dipped into water; and that of being covered entirely with water.

* Mining Engineer, No. 80 Broadway, New York.

Mexican Views.

Mexican Views.

The briquets of both conditions were tested at the end of one, and one-half and six months respectively, and the results compared.

A Rhiele testing machine and briquet moulds having a sectional area at the breaking point of one square inch were used so that no calculations were necessary.

The cement used came from the Concrete Plant, Concrete, Colorado, of the United States Portland Cement Co. through the kindness of Mr. J. E. Zahn.

Tensile strength, pounds per square inch, air for one and one-half months.)

$CaSO_4$		310	324	290	285			302
Na^2SO_3	½	290	283	335	325	235	286	292
,,	1	280	420	338	552	307	320	336
,,	1½	220	280	384	315	346	376	320
,,	2	254	266	342	334	330	210	290
,,	3	308	286	315	310	395	280	316
,,	4	282	283	300	306	380	280	305
,,	5	304	318	290	250	350	352	311
Na_2CO_3	½	290	225	330	417	344	286	315
,,	1	286	294	255		378	402	323
,,	1½	212	292	327	265	288	244	270
,,	2	285	276	246	272	320	282	280
,,	3		345	267	206	368	368	311
,,	4	270	355	376	257	390	314	327
,,	5	252	203	270	375	265	260	268

(Under water for one and one-half months.)

$CaSO_4$		232	300	325	413	376	284	343
Na_2SO_3	½	394	364	280	319	386	300	340.5
,,	1	456	382	452	350	400	285	388
,,	1½	383	410	484	492	442	442	432
,,	2	735	365	336	350	393	424	374
,,	3	355	412	469	486	377	464	427
,,	4	434	467	460	359	424	463	436
,,	5	407	462	408	357	482	460	429
Na_2CO_3	½	436	464	518	418	467	508	469
,,	1	386	443	439	357	422	455	425
,,	2	450	427	384	498	453	453	495
,,	3	422	452	458	440	455	470	450
,,	4	428	427	445	424	414	426	440
,,	5	382	433	386	463	398	440	416

(Air for three months.)

Na_2CO_3	½	387	380	460	446	340	350	394
,,	1	453	400	370	372	423	448	411
,,	1½	340	385	400	316	395	335	369
,,	2	336	425	412	350	350	335	370
,,	3	352	310	393	390	333	420	368
,,	4	350	305	325	382	354	396	352
,,	5	293	303	368	324	408	333	338
$CaSO_4$		347	346	420	390	384	347	377
Na_2SO_3	½	394	394	486	356	310	346	381
,,	1	402	340	398	410	376	400	388
,,	1½	450	450	370	466	300	400	406
,,	2	340	326	336	412	360	350	354
,,	3	346	375	410	375	440	388	389
,,	4	430	346	446	440	450	350	413
,,	5	396	372	358	412	405	365	385

Under water for three months.

$CaSO_4$		328	400	375	482	438	373	395
Na_2SO_3	½	404	429	449	480	435	494	473
,,	1	440	400	380	433	370	426	408
,,	1½	406	374	374	395	406	436	379
,,	2	458	418	472	454	432	415	442
,,	3	396	450	404	407	417	473	425
,,	4	407	417	404	433	415	452	421
,,	5	382	460	397	427	443	404	419
Na_2CO_3	½	408	335	405	356	374	443	392
,,	1	392	365	377	396	434	380	391
,,	1½	383	372	357	363	412	368	376
,,	2	364	287	430	352	333	300	344
,,	3	330	360	435	290	308	312	339
,,	4	350	367	352	412	310	394	364
,,	5	487	440	325	373	440	340	401

(Air for six months.)

Na_2CO_3	½	516	510	468	472	420		477
,,	1	370	400	386	406	360	438	393
,,	1½	316	378	393	372	420	420	383
,,	2	438	430	432	368	422	410	410
,,	3	398	326	310	408	390	334	353
Na_2SO_3	½	350	346	442	410	417	434	398
,,	1	420	376	448	316	500	415	423
,,	1½	466	370	412	386	445		418
,,	2	340	440	435	473	390	412	415
,,	3	350	390	450	456	315	360	421
,,	4	420	325	393	506	502	470	436
,,	5	346	375	410	418	396	340	381
$CaSO_4$		488	544	426	506	460	470	476

(Under water for six months.)

Na_2CO_3	½	495	465	430	500	427	408	454
,,	1	434	468	476	504	465	518	477
,,	1½	463	430	450	485	503	452	464
,,	2	522	450	405	396	455	456	447
,,	3	420	416	492	433	378	408	441
,,	4	460	452	447	456	487	416	453
,,	5	436	480	464	404	460	490	459
Na_2SO_3	½	475	440	507	500	483	440	474
,,	1	476	465	466	497	520	450	471
,,	1½	446	470	496	420	433	440	451
,,	2	412	408	445	410	430	450	427
,,	3	456	477	435	415	380	450	436
,,	4	437	432	460	495	406	478	451
,,	5	380	467	434	393	430	316	430
Neat	1	826	658	780	600	753	740	727
,,	2	1000	795	101	980	876	968	939
$CaSO_4$	1	509	415	446	460	493	453	463
,,	2	476	425	497	465	475	426	461

Conclusions.

The one and one half months tests seem to be of too short duration for satisfactory results. The six months test give grounds for more definite conclusions and in case of future investigation I should make the test at intervals of six months, one year and one and one half years.

The briquets which were placed under water have greater tensile strength in every case. This marked diference may be due in part to the fact that water holds the alkalis in suspension more or less and prevents the formation of weak planes. The different proportions of alkali seem to have very little effect for short intervals. The one exception to this is that increasing amount of sodium carbonate seems to decrease the tensile strength.

From the six months tests it seems that in mixing concrete more than three parts of sodium sulphate or sodium carbonate per 1000 of water, has a slightly deteriorating effect."

PATIO.

Bauxite, a hydrated oxide of alumina, is mined and consumed in increasing quantities, the production of this mineral in the United States during 1914 being, according to a report of the U. S. Geological Survey, 219,318 long tons. Bauxite is used in the production of metallic aluminum and in the manufacture of alumina salts, of bauxite bricks and of alundum. Its use in the production of the metal aluminum is the most important, consuming by far the largest part of the production besides considerable quantities which are imported. Alundum, which is used extensively as an abrasive, is made at Niagara Falls, N. Y., by fusing calcined bauxite in an electric furnace. Alundum is especially efficient for the grinding of steel forgings and castings. Only the best grades of bauxite are used for the manufacture of such chemicals as alum, aluminum sulphate, and aluminum salts, as freedom from oxide of iron is desirable for such purposes. Another use to which bauxite is adapted is in the manufacture of calcium aluminate, which gives a quick set to plaster compositions.

The Geliens process for the amalgamation of refractory ores, consists in the treatment of sulphide and telluride ores with caustic soda and potassium chlorate and aeration during amalgamation. It involves the use of special machinery and special amalgamation plates and has not as yet been employed on a commercial scale.

A coating of concrete applied by means of a "cement gun," liquid, through a hose and nozzle by means of compressed air, has recently been used as a protection of the wooden timbering and metal work in a shaft in a Michigan mine. The coating is applied upon metal athing which serves as reeforcing. It confines the water and preserves the timber by insuring its being always wet, thus preventing the deterioration due to repeated drying and wetting. Similarly t protects steel and iron members from rust. A cement-gun coating is also useful for water-proofing leaky masonry reservoirs, and for cheaply reinforcing steel beams and for resisting abrasion, as in coal-bunker bottoms, etc. For preventing the desintegration of masonry it has been used extensively, as well as for covering roofs and floors and for a variety of purposes. An interesting use is for covering the plate girders of railway bridges which are subject to the abrasive action of the fumes and cinders ejected from passing locomotive stacks.

The presence or absence of a center thread in a fuse has no influence on the speed of burning. The purpose of the thread is merely to make a certain flow of powder in the fuse machine, the presence of sufficient powder being the only essential condition. The size of the powder core does not in itself affect the speed of burning. The speed is governed by the properties of the powder and the methods of manufacture and assembling.

Since the introduction of flotation the demand for pine oils has grown so great that the supply seems to be inadequate, and already there is a diligent search for substitutes. In the processes used in the United States which include the Minerals Separation, Hyde, Janney, Flynn-Towne, Kraut, Ruark and Callow. the oils derived from pitch pine seems to have given the best results on a commercial scale. In Australia, where flotation has been most actively developed, the soluble essential oil of eucalyptus is most widely used. Under the proper conditions any of the volatile oils may be effective frothing agents. The aids to frothing include the turpentines and various pyroligneous products of wood distillation, also the coal-tar phenols and their derivatives as well as the petroleum products, gasoline and kerosene. One company uses castor oil mixed with four parts of kerosene. In processes which do not use the frothing principle and consume oils in large quantities, almost any cheap oil has been employed, including crude petroleum and residues from the refining of crude oil, tar, fish and other products.

Premature explosions in mine blasting are seldom if ever due to "running fuses," a name given to fuse supposed to burn abnormally fast. An inspector who tested hundreds of coils of fuse declares that he has never encountered a sa-called "running fuse." Premature explosions are due to three possible causes. First, if the cartridge is broken a streack of the material may be smeared along the side of the hole when loading. Side-spitting of the fuse may ignite this smear which burns rapidly and may thus ignite the charge. Secondly, in lighting the fuse a spark may accidentally ignite the fuse near the tamping. A third cause is the jumping from one coil to another when the fuse has been injured . Fuse may be easily injured so as to expose the powder train in coiling too tightly.

During the year, 1914, nine persons were on the Rand killed and six injured while in process of charging holes. The causes are various: exudation of nitroglycerine from the casing, forcibly pressisg cartridges in holes of insufficient size, inserting caps, loose, without properly securing them, re-charging holes when the rock was still hot from the preceding charge and charging holes with a drill.

The treatment of zinc ores by leaching and electrolytic precipitation from sulphate solutions gives a very pure product for which the ammunition makers have now made a demand. Before the war the process was scarcely possible commercially, but now prices for the pure metal have risen so high that three plants are being erected in Canada for the production of electrolytic zinc.

Since the introduction of the Butchart riffle, various modifications of the usual Wilfley table top have been used. A table introduced in the mill of the Big Four Exploration Co., Utah, has the four lower riffle extending to the end of the table parallel with its motion. The remaining riffles are given an upward slope toward the feed side of two inches in nine inches, to a diagonal termination, the upper riffles being four feet long. Every alternate sloping riffle is brought out 22 in. parallel with the feed side to a second diagonal termination. Another modification used in the same mill is known as the Thompson riffle. This is the same as the standard riffle except that every alternate riffle is cut off a few inches, forming two parallel diagonal terminations. The Thompson riffle is said to give a cleaner concentrate than the usual riffle, and take care of losses of mineral by returning a small amount of middling.

In the disposal of sand tailings by tramming the maintenance of track is often difficult and expensive. At the Wasp No. 2 mill at Flatiron, S. D. this difficulty has been overcome in a novel way. The tracks sometimes settled as much as three or four feet in a single nigth. The present plan which gives good satisfaction is to support the track by means of wire cables carried over tower supports and anchored to posts in solid ground. The grade of the track rises in both directions from the supporting tower, and the loaded car runs out to the supported end of the track by the momentum which it gains in coming down grade from the loading point to the tower. After unloading it returns by gravity to the tower where a mule is hitched on for the return to the loading point.

Ferromanganese and spiegel-eisen are both pig-irons carrying more or less manganese. The difference is merely in the proportion of manganeses which they contain, ferromanganese, or "ferro" containing from 60 per cent up, and spiegel-eisens from 20 to 30 per cent. The quantity of this alloy used in the manufactured of steel equals about one per cent of the total steel produced.

An improvement in balances of precision has been brought out by Becker, which promises greatly to reduce the labor and drudgery of analytical work and assaying. The fine weights which it is so tedious to place and replace are not used in the new balance. Instead there is a fine gold or platinum chain with one end attached to the beam and the other to a movable support. When a chain is supported at the ends at equal heights, the weight upon the two supports is equal. By raising one end the weight upon the other support is reduced. Each support carries only the weight of the chain from its point of at-

tachement to the bottom of the loop. Advantage is taken of this fact in the new balance. One end of the chain being borne by the beam the other end is attached to a vertical support which may be moved over a graduated scale by mean of a screw in front of the balance. In operation the button or mass to be weighed is place in the pan as usual. The beam is then released and the vertical chain support moved up or down until a correct balance is secured, when the weight is read from the scale. It is not necessary to stop the swing of the beam while changing weights. The relief from strain on eyes and nerves involved in the manipulation of delicate weights will be appreciated by everyone who has spent long hours before the ordinary balance.

Colloid is a form of matter existing as a homogeneous suspension in a liquid, or as a continuous jelly, called a "gel," having pores filled with the liquid. They behave similary to true solutes, unlike them they do not alter the freezing point or the vapor tension of the solvent.

Hitherto the element, cobalt, has been chiefly used in the production of colors, especially blues in pottery. Since large quantities of cobalt are produced as a by-product from the silver ores of Cobalt, Ont. and the market for the usual uses of the oxide have been disturbed, other uses have been found for the metal. Metallic cobalt is now produced and is finding a use in the manufacture of special and high-speed steels, also for plating metals, replacing nickel for this purpose.

From experiments made at Miami, Ariz., it appears that the expense for costly frothing oils in flotation may be greatly reduced by admixture of cheap coal tar. The tar itself does not forth well. It gives a lean froth and requires long treatment. For this reason a small proportion of an oil having good frothing qualities is added. Addition of pine oil gives good results, but pine oil is expensive With the addition of 20 per cent of coal tar products, such as cresol, creosote, etc., a satisfactory mixture is obtained which, with the copper ore used in the experiments, gave excellant results in both the pneumatic and agitation types of machine.

Owing to its use in war, zinc now enjoys ten times its usual demand. The common grades of the metal have increased much more, comparatively, in price than the high-grade material. The premium on high-grade is normally about 40 per cent, while at present it is only about 30 per cent. Some common grades of zinc are redistilled in order to secure a high-grade product, but redistillation does not remove the cadmium, which is objectionable because it interferes in the use of zinc for many purposes. Cadmium is present in redistilled zinc up to 0.2 to 0.4 per cent.

New Publications.

Descriptive Geometry, Third Edition, by H. W. Miller, M. E., Head of the department of General Engineering Drawing in the University of Illinois, Urbana, Illinois. 5×7¼, 149 pages, 98 figures, moroco $1.50 net. John Wiley & Sons, Inc.

Valves and Valve Gears, By Franklin DeRonde Furman, M. E. Professor of Mechanism and Machine Design at Stevens Institute of Technology xi×190 pages. 6 by 9. 170 figures. Cloth, $2.00 net. John Willey & Sons, Inc.

Arithmetic for Carpenters and Builders, By R. Burdette Dale, in charge of Correspondence Instruction, Dept. of Engineering Extension, Iowa State College.

234 pages,5 ¼ by 8, 109 figures. Cloth $1.25. John Wiley & Sons, Inc.

Water purification plants and their operation, by Milton F. Stein, Assoc. Mem. Am. Soc. C. E. Assistant Engineer, Cleveland Filtration Plant, 255 pages, 6 by 9, 95 figures, 11 charts. Cloth $2.50 net. John Wiley & Sons. Inc.

Bauer and Deiss—The Sampling and Chemical Analysis of Iron and Steel By O. Bauer and E. Deisse, of the Royal Testing Bureau at Gross-Lichterfelde, Germany. Translated from the German by William T. Hall and Robert S. Williams, Assistant Professor of Analytical Chemistry, Massachusetts Institute of Technology. International Chemical Series. 373 pages, 5½× 8, 135 illustrations $3.00. An amplified translation from the German, following closely the best American practice. Part I shows in numerous examples taken from metallographic practice, how seriously the analytical results can be influence by incorrect sampling. Part II covers methods of chemical analysis in detail. McGraw-Hill Book Co., New York.

Streeter—Internal Combustion Engines. By Robert L. Streeter, Assistant Professor of Mechanical Engineering, Renselaer Polytechnic Institute. 418 pages, 6×9, 234 illustration $4.00. A well-rounded discussion of fundamental principles, covering both the theory and design of gas and oil engines, with particular emphasis on design. It is designed especially for class and drafting room instruction. It contains a collection useful problems. McGraw-Hill Book Co., New York.

Etcheverry—Irrigation Practice and Engineering. Vol. I—Use of Irrigation Water and Irrigation Practice. By B. A. Etcheverry, Head of the Departament of Irrigation, University of California. 213 pages, 6×9, 103 illustrations $2.00. The first and introductory volume of the series "Irrigation Practice and Engineering." It covers thoroughly and in a practical manner the use of irrigation water and irrigation practice. The author has confined himself largely to irrigation practice in the United States. McGraw-Hill Book Co., New York.

Lucke and Flather—Handbook of Thermodynamic Tables and Diagrams. A selection of Tables and Diagrams from Engineering Thermodynamics by Charles Edward Lucke. Ph. D., Professor of Mechanical Engineering in Columbia University, and John J. Flather, Ph. B., M.M.E, Professor of Mechanical Engineering in the University of Minnesota. 238 pages, 6×9, 87 tables, 82 carts $1.50.

These tables and diagrams have been arranged primarily for use with the authors' Text-book of Engineering Thermodynamics. They should be of considerable value to all students of engineering as well as practicing engineers or others who may have occasion to undertake thermodynamic calculations. McGraw-Hill Bok Co., New York.

Kottcamp—Elementary Mechanics for the Practical Engineer. By John Paul Kottcamp, Head of the Mechanical Laboratory, Pratt Institute. 181 pages, 5½ ×8¼, 85 illustrations $1.50. A practical manual written for the power plant engineer. It aims to present only those principles of mechanics which can be directly applied to the various-phases of power plant operation. The material appeared originally in Power as a part of the Engineers' Study Course. McGraw-Hill Book Co., New York.

Rindsfoos—Purchasing. By C. S. Rindsfoos, C. E., President of the U. S. Purchasing Corporation; formerly Secretary-Treasurer, The Foundation Co. 165 pages, 6×9$ 2.00. Mr. Rindsfoos has prepared this book for the purchasing agent on the basis of a wide experience. It covers completely and in a practical manner the important features of the subject. McGraw-Hill Book Co., New York.

Hale—Practical Applied Mathematics. By Joseph W. L. Hale, E.E., Associate Professor of Engineering, Pennsylvania State College; detailed as Supervisor Apprentice Schools, Pennsylvania Lines East of Pittsburgh and Erie. 206 pages, 4½×7, 184 illustrations $1.00. A useful text for apprentice, trade and vocational schools. It has been designed for use in the apprentice schools of the Pennsylvania Railroad Company. McGraw-Hill Book Co., New York.

Hale—Practical Mechanics and Allied Subjects. By Joseph W. L. Hale. 228 pages, pocket size, cloth, 201 illustration $1.00. A companion to "Practical Applied Mathematics" by the same author. It is essentially a presentation of problems arising in shop experience in the mechanical trades. It contains an unusual collection of class-room problems for trade, vocational and technical high schools. McGraw-Hill Book Co., New York.

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ASK FOR CATALOGUE.

PERSONALS.

R. B. Brinsmade of Puebla was a recent visitor to Mexico City.

C. V. Allen, manager of the Cia. Ingeniera, Importadora y Contratista, S. A. is on a two-months visit to New York, his headquarters for the time being the Westinghouse Electric Mfg. Co's export office at 165 Broadway.

W. J. Graveling, assistant manager of the Republic Mining and Metal Co. has returned to Mexico City after several months stay in El Paso.

Victor M. Braschi is recovering from a month's siege of illness.

John Jeroloman, engineer with the Mezquital Mining Co. at Mezquital del Oro, Zac. has returned to his post.

Charles Draper, cyanide superintendent at the remodelled mill of the Mezquital Mining Co. is in the States.

E. A. Strout, manager of the La Fe Mining Co., Guadalupe, Zac. has arrived in Mexico City.

Tom Mitchell is mill foreman for the Mezquital Mining Co., Mezquital del Oro, Zac.

C. E. Rhodes, of El Oro Mines & Railway Co., is in Mexico City awaiting an opportunity to return to El Oro.

A. W. Edelen, manager of the A. S. & R. Co at Angangeo, Mich. and C. A. Stuart, engineer for the same company, have returned to the property.

Henry Sunday is at Mezquital del Oro, Zac.

Charles Hoyle, manager of the Esperanza Co., and Olive Newcomb were last month both receiving the congratulations of the American colony in Mexico City —a lusty son and a charming little mite of a daughter.

R. M. Raymond has been in New York.

Chas. P. Miller is with the Arkansas & Arizona Copper Co. at Jerome Ariz.

H. A. Mac Clyment is in Riverside, Cal.

H. W. Edmondson, is with the Concheño Mining Co., Temosachic, Chi.

Syd. D. Kempton is located in the Lawler Building, Prescott, Ariz.

E. H. Leslie, formerly of the Mexican Mining Journal staff, is in charge of the Chicago office of the Mining Press.

Fred F. Meloche is in Ketchikan, Alaska.

Robert Allen is at Eiffel Hats, Rhodesia.

P. C. Wilson has returned from Arizona to Oakland, Cal.

H. B. Lawrence is at Golconda, Ariz.

L. F. Carrouché has returned to Mexico.

S. R. Coghlan has returned from Peru, having resigned as assistant superintendent of the smelter at Cerro de Pasco.

H. C. Carlisle has returned to Tonopah, Nev. from Nicaragua where he has been for the past year in the interests of the Tonopah Min. Co.

Donald F. Irvin has returned to Pasadena, Cal. from Central America and the canal zone.

Frank H. Sistermans and D. M. Munro, recently returned from Mexico, are attending the Engineering Congress at San Francisco Cal.

B. F. Wade has joined the staff of the Redwood Manufacturing Co. with headquarters in the Hobart Building, San Francisco, Cal.

J. E. McCarty and J. L. Wilcox have arrived in Nogales from the Alamos district, Son.

Frank Curtis, superintendent of the El Oro gold mines in Sonora has been in Tucson, Ariz.

H. E. West has returned from Peru to Berkeley, Cal.

George A. Denny who recently left Mexico, has arrived in Liverpool.

Howard Bancroft of Denver, Colo, has gone to Bolivia.

Harry Huntington Miller, manager of the Cia. Anonima Mineral lo Increible, has returned to the company's property at Yuruary, Venezuela.

G. W. Rudyerd has returned to England from Venezuela.

C. A. Hamilton of Taviche, Oaxaca, is at the Iturbide, Mexico City.

D. C. Brown has been elected first vice-president of the Cia. Metallurgica Mexicana.

The office of J. V. N. Dorr and the Dorr Cyanide Machinery Co. is now at No. 17 Battery Place, New York.

Horace V. Winchell has moved his offices to 826 First National-Soo Bldg, Minneapolis, Minn.

F. L. Bosqui has opened an office at No. 1 London Wall Bldg. London, Eng., as a consulting metallurgical engineer.

A. J. Eveland is in New York City.

Thos. T. Read, for several years connected with the staff of the Mining and Scientific Press, is with the Engels Copper Co. Engels, Cal.

Theodore P. Holt is superintendent of the Tintic Milling Co., Silver City, Utah.

Benjamin C. Rogers is with the department of geology of the Detroit Copper Co., Morenci, Ariz.

Walter E. Burlingame announces that the business of E.E. Burlingame & Co. assayers and chemists, will be conducted under his name at 1736-38 Lawrence St., Denver, Colo.

P. C. Schraps of the South American Development Co., has arrived in New York from Ecuador.

W.D. Burcham has left the employ of the Presidio Mining Co. to open up property in the Terlingua quicksilver district, Texas.

Spruille Braden, son of William Braden of the Braden Copper Co., and Miss Maria Solar de Humeris, were married Sept 15 at Santiago, Chile.

E.C. Hall in on a visit to the States looking after business interest in Oregon.

TRADE NOTES

The Asbestos Protected Metal Co., of Pittsburgh, Penn., announces the removal of its Detroit office to 2011 Dime Bank Building.

The American Steel Foundries has installed a six-ton electric furnace of the Heroult design at its Indiana Harbor, Ind., plant for the manufacture of extra-quality steel castings.

The American Steel and Wire Co. has been awarded a grand prize by the Panama-Pacific International Exposition for the superiority of its products and the high character of its exhibit.

W. E. Hardy, for the last 11 year connected with the Diamond Rubber Co. and the B. F. Goodrich Co., has been appointed sales manager of the Boston Belting Co., Boston, Mass., manufacturers of mechanical rubber goods.

The Hardinge Conical Mill Co. has received an order from the Nevada Consolidated Copper Co. for two 8-ft. Hardinge mills, to be used with iron balls, also an order from the Dome Mines Co., Ltd., of South Porcupine. Ont., Canada, for two 8-ft. ball mills. These ball mills are to take the place of stamps now in use at the Dome company's plant.

Frederick T. Snyder, president of the Snyder Electric Furnace Co., 53 W. Jackson Blvd., Chicago, Ill., will deliver a paper before the October meeting of the American Chemical Society in Pittsburgh, describing an electric furnace for carrying out industrial operations at temperatures above 2,000° C., with a holding capacity of 10 cu. ft. of charge.

Bausch & Lomb Surveying Instruments received the Grand Prix at the Panama-Pacific Exposition for "general design and excellence of quality." Among the features of these instruments which secured for them the highest award are: recalculated lens system with maximum apertures; interior focusing; water-proof construction; tarnish-proof graduations and the tubular tungsten magnetic needle.

The Nordberg Mfg. Co., Milwaukee, Wis., announces that it has recently received orders for electric hoists from the following mining companies: Anaconda Copper Mining Co., Canadian Copper Co., Mond Nickel Co., Ray Consolidated Copper Co., United Verde Extension Mining Co., Consolidated Arizona Smelting Co., Magma Copper Co., Cerro de Pasco Mining Co., and Morococha Mining Co.

Bulletins 600 and 1000 of the Pacific Electric Manufacturing Co., San Francisco, deal with high-tension switches, disconnecting switches in the former, and fused isolating links in the latter.

Flotation Oil Circular No. 7 of the Pensacola Tar & Turpentine Co., Gulf Point., Florida, discusses its products with frothing and selective qualities. Prices are given for 12 oils, retail or in bulk.

The Mable Mining, Milling & Power Co., Knik, Alaska, has given the Denver Quartz Mill & Crusher Co., of Denve , Colorado, an order for the equipment for a free-milling plant, consisting of one steel crusher, one ore-feeder, one quartz-mill, amalgamating-plates, etc., made by the company.

The Sterling Motor Truck Co., West Allis, Milwaukee, Wisconsin, has published a large illustrated sheet describing its Sternberg dump-trucks. These are made in five sizes namely, 1500 lb., 2, 3, 5, and 7-ton capacity. The Sterling wormgear type, with motor under hood, is made in 1500 lb., and 3-ton sizes.

A novel method for advertising has been adopted by the Charles A. Schieren Co., makers of leather belting, at its exhibit at the Panama-Pacific Exposition. Each visitor to the Company's booth in the Palace of Machinery, Avenue G and Second street, is given a numbered coupon which gives him an opportunity to secure without charge a Keuffel & Esser sliderule, six of which will be given away on Machinery Day, September 25.

Electric furnaces of the Snyder type are being installed by the Thomas Davidson Manufacturing Co., of Montreal, Canada and the Canadian Brakeshoe Co. at Sherbrooke. High-grade steel is to be made in them. In a paper read before the American Electrochemical Socicty at San Francisco on September 16, electric steel cost were discussed by F. T. Snyder, of the Snyder Electric Furnace Co., Chicago.

The medal of honor for self-contained

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.490	58.519	50 250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	59.890	56.471	49.034	27.198	25.948	23.267
July	56.721	54.678	47.519	27.074	25.218	22.597
August	59.293	54.344	47.183	27.335	25.878	22.780
September	60.840	53 290	48.860	27.988	24.260	23.591
October	60.793	50.854	.....	28.083	23.189	.....
November	58.965	49.062	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.800	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

MONTH	New York Electrolitic		London			
			Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	.....
March	14.131	14.787	64.276	66.152	69.170	.....
April	14.211	16.811	64.747	75.096	69.313	.....
May	13.996	18.506	63.182	77.600	67.786	95.333
June	13.608	19.477	61.336	82.574	66.274	91.409
July	13.223	18.799	60.540	76.011	64.055	82.333
August	.....	18.641	.....	86.873	.....	.....
September	.....	17.502	.....	69.915	.....	.....
October	.....	.....	.....	.....	.....	.....
November	11.739	.....	58.227	.....	.....	.....
December	12.801	.....	56.841	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....

TIN

Month	New York		London	
	1914	1815	1914	1815
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.555	176.925
March	38.038	48.426	173.818	180.141
April	36.154	47.884	163 883	166.225
May	33.360	38.790	150.702	162.675
June	30 577	40.288	138.321	167.636
July	31.707	37.423	142.517	167.080
August	.....	34.389	.....	151.440
September	32.875	33.125	.....	152.825
October	30.284	.....	.....	.....
November	33.304	.....	139.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	.....	.....

LEAD

MONTH	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4 048	3.827	3.937	3.718	19.606	19.122
March	3.970	4.053	3.950	3.997	19.651	21.883
April	3.610	4.221	3.696	4.142	19.225	21.094
May	3.900	4.274	3.909	4.182	18.503	20.347
June	3.600	5.632	3.810	5.939	19.411	25.170
July	3.891	5.659	3.739	5.531	19.051	24.611
August	3.675	4.659	3.715	4.520	.....	21.948
September	3 829	4.610	3.959	4.490	.....	23.151
October	3.528	... ..	3.384	....	.....	.....
November	3.663	... ..	3.595	.....	18.500	.....
December	3.800	.....	3.962	.....	19.097	.....
Year	3.862	.....	3.737	.....	.....	.....

SPELTER

MONTH	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	68.100
June	5.000	21.209	4.850	21.038	21.345	100.614
July	4.920	19.028	4.770	18.859	21.569	97.250
August	5.569	12.791	5.418	12.611	.....	67.766
September	5.360	13.440	5.230	13.270	.....	67.941
October	4.909	.....	4.750	.....	.....	.....
November	5.112	.....	4.962	.....	25.018	.....
December	5.562	.....	5.430	.....	27.389	.....
Year	5.213	.....	5.061	.....	.....	.....

New York and St. Louis quotations, cents per pouud London, pounds sterling per long ton. *Not reported. London Exchange closed.

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

AMERICAN SOCIETY OF MEXICO.

The Society of the American Colony of Mexico City has been reorganized on broader lines, under the name of "The American Society of Mexico."

At a mass meeting recently held in the City of Mexico a new Board of Directors was elected, together with the following named officers: President: R. M. Raymond; Vice President, Dr. Sidney Ulfelder; Secretary, J. D. Helm; and Treasurer S. S. Conger.

At a later meeting the Society adopted a new Constitution and By Laws, providing for permanent organization. This is broad in scope, to cover present and future needs.

The object of the Society as stated, is to promote the welfare of the American residents of the Republic of Mexico. Among other powers the Society is authorized to take cognizance of and act upon all subjects of general interest of its members; to promote and establish mutual cooperative relations; to cooperate with and assist other American institutions of Mexico; to provide, when expedient, a home or house for the accommodation of its members; and to acquire property when desirable for the uses of the Society.

All properly recommended nationals of the United States of America, either men or women residents of the Republic of Mexico, may become members of the Society by signing cards of registration.

The principal office of the Society is to be in the City of Mexico, but branch offices may be established elsewhere.

Heretofore the membership has been limited to men, but in the reorganization the women are invited to join. The present membership of about 1,300 will at once be largely increased.

A cordial invitation is extended to all Americans, men and women, throughout the Republic to identify themselves with this movement for mutual benefit. Naturally the Society will be non-political and non-sectarian. It is also entirely democratic and requires of applicants nothing more than a recommendation as to good character.

It is hoped that Americans of all occupations throughout the Republic will recognize the importance of such an organization and will identify themselves with it. If they do real benefits can be secured for all concerned.

There is need for a strong Society and better opportunities for acquaintance than have heretofere existed among the Americans so widely scattered over this great and undeveloped country. It is important that more and reliable information be had of the Americans living in Mexico, and that a common channel of communication be provided for various purposes. This will give an opportunity for united expression of sentiment and united action in matters relating to the common good. It will make possible a registration of American residents that has not existed heretofore.

When the plans are fully developed in the course of time the Society will be able to provide a Club or meeting place for Americans from all parts of the Republic when they visit the capital; meantime it can be made useful as a source of information to non-resident members.

All who feel an interest are invited to correspond with.

J. D. HELM, Secretary.

408 LA MUTUA, MEXICO, D. F.

mine-rescue apparatus has been awarded to Siebe, Gorman & Co., Ltd., by the superior jury of the Panama-Pacific Exposition. H. N. Elmer, general agent, 1140 Monadnock Block, Chicago, has appointed E. D. Bullard & Son, 268 Market street, San Francisco, to be his Pacific Coast agents for the sale of Proto, (Fleuss-Davis patents), self-contained oxygen breathing-apparatus and other first-aid and rescue-equipment manufactured by the company.

Bulletins No. 1096, 1412-A, and 1635 of the Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin. deal with direct-current motors and generators, types "K" and 'KC'; crushing rolls; and the hydro-electric plant of the Cerro de Pasco Mining Co., Peru, respectively. The K motors are designed to meet severe service. The KC is an adjustable speed motor similar in design to the K type. Rolls are being used in larger numbers at mines, and the details of construction are timely. The Cerro de Pasco plant, all of A-C manufacture, consists of three 3750-kw. generators each driven by two 2500-hp. impulse water wheels at an altitude of 12,000 feet.

The Denver Quartz Mill & Crusher Co.'s catalogue No. 12 describes and illustrates its mills, starting with the first one made in 1908. This had seven 300-lb. rolls, weighed a total of 4500 lb., and crushed 10 tons per 24 hours with a concumption of 8 hp. The latest, or No. 3 mill, has four 3200-lb. rolls, weighs 32,000 lb., and crushes 100 tons per day, using 18 hp. A roll-tire from a No. 1 machine crushed hard tungsten ore for six months. It retained its shape even when reduced to 60 lb. from the original 330 lb. Six sizes of steel rock-crushers are made, also a simple ore-feeder of large capacity, and the Kidd placer mining compound riffles.

Continuous counter-current decantation is discussed in Catalogue No. 7 of the Dorr Cyanide Machinery Co., Denver, Colorado. The process consists of operating a series of Dorr continuous thickeners in such a manner that the solids, with a small portion of liquid, pass sucecessively from one thickener to the next, being finally discharged from the last thickener as tailing.

A plan to eliminate the personal equation in bullion assaying is used in the Salida smelting works, Colo. The fused and poured samples come into the assay office in the form of irregular drops in the usual way. These are weighed without trimming, so that there is no uniform definite weight of charge. After cuppelling and parting, the assayer reports the actual weights of the sample taken and the silver and gold recovered. The calculations are then made in the office on a machine. In this way the assayer is not tempted to make his results check, for until the calculations are made he does not know whether they will check or not.

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*Máquinas y Tecnología Mecánica.**

Con la premura que el Director de esta Revista me ha pedido un artículo para llenar una página del número destinado a conmemorar el Cincuentenario de la Facultad de Ingeniería, y el poco espacio destinado al mismo, véome forzosamente obligado a hacer sólo unas ligeras consideraciones sobre la enseñanza de las máquinas, tema elegido con este propósito.

La enseñanza de las Máquinas y de la Tecnología Mecánica que, como profesor de las mismas, tuve el honor de establecer por primera vez en nuesta Facultad en los años de 1884 y 1894 respectivamente, son materias de la mayor importancia para el ingeniero y ambas enseñanzas pueden considerarse bajo dos aspectos distintos.

Por lo que se refiere a la primera materia(Máquinas), estos dos aspectos son: 1º, construcción y 2º, explotación o funcionamiento y en cuanto a la segunda (Tecnología Mecánica) ellos son: 1º, conocimiento de los principios fundamentales de la transformación mecánica de la materia bruta, y 2º, conocimiento especial de los medios empleados para la fabricación de cada objeto.

Dada la naturaleza de las industrias establecidas en nuestro país y las que pueden establecerse aún, mientras no nazcan y se desarrollen las industrias mineras, ¿cuál es el rumbo que debe considerárseles con preferencia? es lo que me propongo dilucidar someramente.

Al sentar la proposición queda casi contestada de por sí, al menos en lo referente a la enseñanza de las máquinas: no habiendo hierro ni carbón es inútil pensar en construir máquinas, pero en cambio, en casi todas las industrias establecidas son necesarias las máquinas, es de suma importancia para el ingeniero conocer su perfecto funcionamiento y las causas de las perturbaciones que pueden producirse para poder hacerlas desaparecer, así como componer y cambiar piezas que hayan sufrido desperfectos.

Considero, pues, que es mucho más importante para el ingeniero del país, perfeccionarse en la explotación de las máquinas y no en los detalles de su construcción y sus últimos perffeccionamientos, sobre los cuales basta que tenga u nocnocimiento somero a fin de tenerlo en cuenta en las especificaciones que tenga que hacer al adquirir las máquinas en las fábricas extranjeras.

Con esto quiero decir por otra parte, que los proyectos y dibujos detallados de máquinas exigidos a los alumnos de la Facultad deben reducirse a un mínimum, puesto que por ahora y aun por mucho tiempo más no tendrán motivo para poyecttar una máquina a vapor, bombas, grúas, etc., y en cambio constantemente tendrán ocasión de instalar esas máquinas y hacerlas funcionar, pudiendo así llenar con otros estudios más útiles el tiempo no despreciable que exige el dibujo casi siempre complicado de una máquina.

Para comprender bien el funcionamiento de las máquinas es necesario que su estudio esté basado en los principios científicos y técnicos adecuados, de modo que desde este punto de vista no se diferencia de la faz constructiva; lo que sí puede hacerse con más facilidad, pues la parte gráfica se reduciría a esquemas y diagramas.

Dado por otra parte el tiempo y el lugar destinado al curso de máquinas en el plan de estudios de la Facultad, con el desarrollo indicado se conseguiría dar al ingeniero civil una preparación bien redondeada y más e narmonía con la finalidad de sus funciones.

Pasando por otra parte el tiempo y el lugar destinado al curso de máquinas en el plan de estudios de la Facultad, con el desarrollo indicado se conseguiría dar al ingeniero civil una preparación bien redondeada y más en armonía con la finalidad de sus funciones.

Pasando ahora al estudio de la Tecnología Mecánica dedicada especialmente a los ingenieros mecánicos, debemos afirmar que un año de estudios con sólo seis horas semanales según marca el plan de la Facultad, es completamente insuficiente para dominar la materia siquiera medianamente. En efecto, basta mencionar sólo algunas de las industrias que abarca, como ser las que se refieren a todas las transformaciones de los metales y de las maderas con sus innumerables maquinarias; la fabricación de hilados y tejidos; la fabricación del papel, etc., etc., para darse cuenta de lo que dejamos dicho. Luego entonces, mientras no se reforme el plan general de estudios creanda las verdaderas especialidades, dando a la del ingeniero mecánico el lugar de importancia que le corresponde, y mientras no se destine sino un año a materia tan principal como la Tecnología, soy de opinión que debe empezarse su estudio con los principios fundamentales que rigen a la transformación de la materia bruta, siguiendo las huellas establecidas por Karmarsch en su notable obra de Tecnología Mecánica general, lo que tiene alumno desde el primer momento el la gran ventaja de hacer abarcar al alumno desde el primer momento el conjunto del vasto campo en que se desenvuelven todas las industrias. En esta materia es ilógico hacer proyectar y dibujar a los alumnos un torno, una cepilladora o una fresadora, pues quizás nunca o por lo menos hasta dentro de largo tiempo tendrán ocasión de construirlas. Para estudiar las tecnologías especiales, como ya dijimos, no hay tiempo suficiente en un solo año, luego pues si quedara tiempo disponible después de estudiar la tecnología general, creo que podría llenarse con el estudio descriptivo de las máquinas útiles de elaboración de metales y maderas, pues su uso es de los más generalizados en el país. En las horas destinadas a la práctica podrían hacerse proyectos y planos generales de ubicación de usinas o talleres de los más necesarios para el desarrollo de las industrias, que es lo que más frecuentemente tiene que hacer el ingeniero entre nosotros; y como en estos casos se trata solamente de dibujos en forma esquemática, no presentan dificultad alguna aunque no se tengan conocimientos de los detalles constructivos.

Concluyo aquí estas breves consideraciones sobre la enseñanza de las materias a que me refiero, pues un estudio más profundo del asuto adnquiriría una extensión tal que no encuadraría en una revista de esta índole.

El número de estaciones radiotelegráficas permanentes, en servicio a comienzo de 1914 era: Canadá 32, Inglaterra 25, Rusia 22, Alemania 20, Italia 20, Brasil 16, India 11, España 9, Francia 8.

* Escrito por el Sr. Ing. Otto Krause en ingeniería.

Nuevos Procedimientos para Obtener Gasolina de los Residuos de la Destilación del Petróleo.

En los últimos años, la industria de la destilación y refinado del petróleo, ha experimentado grandes progresos a consecuencia de la constante demanda de todos sus productos derivados y en particular de los conocidos con el nombre genérico de "naftas" o "gasolinas" o sean los productos ligeros, considerados como de escaso valor.

Hasta hace poco, los productos del petróleo más aceptados en los mercados eran los kerosenes ,los aceites lubrificantes y las parafinas, productos cuya demanda variaba con los países y las cotizaciones respectivas, de modo que ya era ventajoso tratar petróleos ricos en aceites lubrificantes, porque en ese momento, eran esos productos los que se vendian con más beneficio, ya otras veces al contrario, había interés de producir petróleo lampante o parafinas.

Estas consideraciones explican el hecho extraño, constatado en los Estados Unidos, de que en ciertas ocasiones el kerosene ha valido más barato que el petróleo bruto del cual se le extraía. En ese caso, el kerosene que frecuentemente constituye el principal producto de la destilación, no venía a ser sino un subproducto, tomando los aceites pesados el prime rrango.

Pero desde que la marcha de los motores de explosión fué práctica e industrial y además el automovilismo terrestre y marítimo entró en el rol de las aplicaciones usuales, las gasolinas vinieron a ser productos solicitados y pronto se vió que toda su producción no era suficiente para satisfacer al consumo cada vez más creciente. Así, mientras que en el año de 1898, en los Estados Unidos la producción de la nafta fué de 17.258,000 de galones con un precio medio de 6 centavos oro por galón, la producción en 1912 fué de.... 186.000,000 de galones con un precio medio de 11 centavos oro el galón y en 1913 fué de 280.000,000 de galones y el precio en 1914 (antes de la guerra) llegó a 21 centavos oro galón.

Un aumento extraordinario de naftas se ha obtenido también en los demás países petroleros, habiéndose llegado a pagar en 1913 por petróleos crudos de Perehinsko y Rypne (Austria), ricos en benzinas, hasta £5 por tonelada y más o menos igual precio por petróleos crudos de Bana (Rumanía) y de Yza (Hungría).

La demanda de las naftas y el aumento de sus precios, ha hecho que se busque no solo de tratar de preferencia los petróleos ricos en esencias, sino que se trate de obtener de todos los petróleos, mejores rendimientos en su destilación, sea por perfeccionamientos introducidos en ésta, sea por la adopción de procedimientos completamente nuevos con la ingerencia de nuevos elementos de acción, tales como la sobre-presión y los agentes químicos. En la demanda, se ha llegado hasta utilizar para el caso los llamados gases naturales que se desprenden de los pozos de petróleo, con los que se ha logrado general naftas que en buena proporción, se consumen hoy en los mercados.

Por el interés que tales progresos en el mejor aprovechamiento de los petróleos naturales, puede traer al país productor de esa substancia daré a conocer el estado actual de los últimos perfeccionamientos introducidos para generar las gasolinas.

El petróleo, como se sabe, en síntesis es compuesto esencialmente de hidrógeno y de carbono unidos en la forma de hidrocurburos de composición variable y constitución compleja llevando frecuentemente pequeñas proporciones de óxigeno, azufre y ázoe.

Los diferentes petróleos que se encuentran en la naturaleza son compuestos de una mixtura de diferentes hidrocarburos con aspecto y composición diferentes, pero todos ellos en general, pueden considerárseles comprendidos dentro de los dos tipos:

a(Petróleos asfálticos, aquellos que rinden a lenta destilación, un residuo oscuro asfáltico, el cual es inmediatamente atacado por ácidos y disuelto en disolventes usuales.

b) Petróleos parafinosos, los que rinden en reducción a baja temperatura, una apreciable proporción de hidrocarburos sólidos, ligeramente coloreados, sobre todo de la serie de las parafinas, los que no son atacados fácilmente por ácidos y disolventes normales.

Tanto los petróleos crudos de carácter asfáltico, como parafinoso, son compuestos de una variedad de hidrocarburos de diversas densidades y de diferentes puntos de hervir, de modo que cuando se les somete al calor, los varios constituyentes hidrocarburados del petróleo tienden a separarse tanto como se aproxima la temperatura de su punto de hervir.

La determinación de los compuestos hidrocarburados constituyentes del petróleo y su separación, es una operación difícil, lo cual es notablemente complicado por:

a) La existencia de los que son conocidos como "isómeros," es decir, de hidrocarburos de la misma composición química cuantitativa, pero que poseen diferentes cualidades con motivo de la diferente agrupación o disposición de los átomos en las moléculas.

b) El acontecimiento del fenómeno llamado "cracking" por el que durante el proceso de la destilación, los hidrocarburos de una composición son reducidos o los más bajos miembros de la misma serie o aún convertidos en otras series de hidrocarburos.

"Reconocemos, dice el conocido químico Dr. David T. Day, que la separación de esta gran mixtura en aceites todos simples, está lejos de su posibilidad, pues mientras se separan estos constituyentes, muchos de ellos se desdoblan todavía en otros nuevos aceites por los agentes que se usan en la separación (calor, reactivos químicos, etc.)

"Mientras tanto es un hecho que se pueden agrupar los aceites componentes en pocas "series homólogas" y dentro de cada serie, cada aceite difiere del próximo miembro por un determinado monto de hidrógeno y carbono y con diferencia en el punto de hervir, lo que hace posible ciertos métodos de separación. Hay similar diferencia en viscosidad, gravedad específica, etc., cuyas propiedades son también valiosas para ayudar la separación."

Dichas series las constituyen:

Los hidrocarburos saturados Cn H^{2n} $+^2$.

Los hidrocarburos aromáticos Cn H^2n.

Los carburos etilénicos Cn H^2n y acetilénicos Cn H^2n-2.

Los carburos aromáticos Cn H^2n-6.

Dentro de cada serie existen muchos miembros que difieren notablemente unos de otros. Así en la serie de los hidrocarburos saturados Cn H^2n+, homóloga del gas de los pantanos, se tiene que la parafina es el límite superior, mientras que el metano C H^4 que se gaseoso, que se presenta en gran cantidad disuelto el petróleo que forma el principal constituyente del gas natural, es el más bajo miembro de la serie de las parafinas. El metano es un hidrocarburo saturado que contiene en peso, el máximo porcentaje de (75 por 100) y el mínimo porcentaje de carbono (25 por 100) y los demás miembros de la misma serie contienen un mayor porcentaja de carbono y más bajo porcentaje de hidrógeno.

Bajo el punto de vista comercial, los petróleos se clasifican según la proporción de esencias o naftas y de petróleo iluminante o kerosenes que son susceptibles de dar por destilación, conviniéndose en considerar, según el método adoptado de Engler, como Benzinas, aquellos productos que destilan hasta 150° centigrados o sea 352° Fahr y como petróleos iluminantes aquellos que destilan entre 150° y 300° centigrados (302° a 572° Fahr.)

Como se sabe, cuando se somete el petróleo crudo a la acción del calor, regulándolo de modo de aumentarlo progresivamente, los compuestos que lo constituyen se desprenden sucesivamente por orden de volatilidad, al mismo tiempo que la masa se modifica bajo la influencia de las acciones pirogénicas.

En este fenómeno, que ejecutado en escala comercial, constituye la destilación y refinación del petróleo, se ha llegado a establecer: que no hay duda que llegado cierto momento de la operación, ciertos carburos sufren una descomposición más o menos completa y generan a la vez hidrocarburos más simples y de términos más altos; que la destilación parece tener por efecto el dar a los hidrocarburos que constituyen el petroleo, o por lo menos a aquellos que son susceptibles de descomposición durante la destilación, más estabilidad.

De ahí que petróleos de carácter general similar, no consistan necesariamente en una mixtura de los mismos hidrocarburos. Así, dos petróleos rindiendo aproximadamente la misma proporción de buena clase de benzina, kerosene y aceites lubrificantes, pueden estar compuestos de una mixtura de hidrocarburos completamente diferentes, pertenecientes a series químicas totalmente distintas. Es por esto que en la práctica de la destilación, no solo hay que tener en cuenta las propiedades físicas, sino también las propiedades químicas de los hidrocarburos que se tratan.

Tal como en la actualidad se encuentra el arte de la destilación, en el curso de ella se obtienen los siguientes grupos de productos:

a) Nafta cruda.

b) Petróleo de quemar (gas oil).

c) Un destilado mezclado de hidrocarburos con punto de ebullición como nafta, y con punto de ebullición a más alta temperatura y con viscosidades variadas.

d) Destilados espesos de parafina.

e) Zupías espesas de parafina.

f) Cera cruda de alambique o zupías de cera.

Según el desarrollo histórico, un primer progreso en la manufactura de los productos livianos, tales como las gasolinas y los kerosenes, para obtener su pureza, fué el tratar los productos ligeros destinlados con SO^4; mediante la acción del ácido frío y suficientemente fuerte, puede destruirse y así separarse todos los grupos con excepción de los que se llaman hidorcarburos parafinosos y si se usa el calor, fácilmente atac: también todos los hidrocarburos parafinosos arrastrados durantet la destilación preliminar. Esta operación es la que constituye el refinado.

Otro progreso, a fin de aumentar el rendimiento en productos livianos, especialmente en petróleos lampantes, ha sido la generalización del uso en todas las refinerías modernas, del "cracking" durante la destilación, operación que como su nombre lo indica, no es un simple rompimiento, sino una verdadera disociación que se produce cuando ciertos hidrocarburos pesados están sometidos a una temperatura superior a su punto de ebullición. En este caso, los destilados siendo recolectados en la parte superior del alambique y dejando su domo expuesto a la atmósfera, parte de los productos de la destilación, son condensados por ese medio y origina su caída dentro del fluído caliente. El resultado de tal acción, es la duración del hidrocarburos en productos de baja densidad y bajo punto de hervir, acmpañado por la formación de una cierta cantidad de gas permanente.

La exacta acción del cracking, parece poco conocida y generalmente es entendido que los petróleos "cracked," son inferiores a los "uncracked" y por ello requieren más refinado.

Un reciente progreso en el desarrollo de la refinería del petróleo, ha sido la aplicación industrial del uso de la sobrepresión durante la destilación, con lo que se ha logrado fabricar muy económicamente gasolinas del resíduo de la destilación de los petróleos o sea de los aceites densos combustibles, gas oil, etc., mediante la destilación de ellos bajo presión superatmosférica.

El principio en que se funda este procedimiento es teóricamente conocido desde mucho tiempo. Así Riche y Halphen en su obra "Le Pétrole", pág. 149, dicen: "Las interesantes investigaciones de S. Hana Hayes, han mostrado que los productos ligeros del petróleo, pueden ser trasformados en aceites pesados cuando se les calienta bajo presión, en presencia del vapor de agua.

"Sometiendo a la destilación bajo presión la parafina, los señores Thorpe y Young, han hecho gran luz sobre la naturaleza de las reacciones pirogénicas debidas al cracking, ellos han establecido que los carburos pesados de la serie grasa, se descomponían no sólo en términos más simples; sion en hidrocarburos de la serie de las parafinas."

"Los fenómenos de descomposición son conforme a la teoría de disociación de los hidrocarburos, formulada por M. Bertelot. Ellos generan compuestos más estables, generalmente menos ricos en hidrógeno que los hidrocarburos de los que provienen.

El Dr. Dayid T. Day, en 1913, en su conferencia en Londres, decía "Ciertos petróleos mexicanos, contienen naturalmente solo 2 por 100 de gasolina, pero por lento calentamiento, aquellos petróleos se quiebran y pueden rendir de 7 a 8 por 100 de gasolina. Pero aquellos llamados cracked, son mal olientes y dificultan la refinación. Hace varios años, he encontrado que si esos petróleos son destilados bajo presión, el rendimiento de gasolina es aun aumentada más y que el mal olor debido a la deficiencia de hidrógeno en la composición, puede remediarse por la combinación inmediata del hidrógeno con el aceite dentro del alambique, bajo la influencia de un agente catalítico. Recientemente, la demanda por toda especie de gasolina ha hecho dejar de lado el requisito de buen olor, y mediante otros procedimientos se produce mucha gasolina sintética. Por tales medios, resíduos de bajo grado han podido rendir de 29 a 70 por 100 de su peso el material que sirve como gasolina."

El procedimiento de generar las gasolinas por tales medios, no fué generalizado desde el principio, apesar de sus ventajas: 1o. porque no había suficiene demanda de gasolinas, y 2o. porque la aplicación del principio traía consigo ciertos riesgos en su operación. Así, la descomposición que se verificaba mediante la acción combinada del calor y la sobre presión, con la formación de productos ligeros, originaba también la producción de aceites pesados y carbón libre, cuya proporción dependía del grado al cual se llevaba la operación. Como el carbón libre se depositaba en el fondo del alambique, formando costras duras (red spots), no era práctico, en el estado presente del arte, conseguir el resultado mediante la destilación destructiva bajo presión hasa sequedad. Pero recientes perfeccionamientos introducidos en la aplicación del principio, ha permitido llevar con éxito toda la operación, sin riesgo ni demoras, y así obtenerse procedimientos realmente industriales.

Hoy en los mercados se venden los productos titulados "Motor spirits," así llamadas las gasolinas no muy puras, fabricadas de los residuos de la destilación de los petróleos, mediante el procedimiento de la destilación bajo presión, y dichos motor spirits hacen fuerte competencia a las gasolinas aromáticas obtenidas en la destilación.

Los motor spirits, tienen en término medio, 60° Baume de gravedad, con un pronunciado olor, un color paja y se pretende que están compuestos principalmente de hidrocarburos de la serie de las parafinas.

Dichos motor spirits son fabricados en su mayor proporción por la Standard Oil Co. de los Estados Unidos, por medio del procedimiento Burton. Así, la Standard Oil Co. logra producir gasolinas que se venden a 3 centavos oro más barato por galón.

Como tan favorables resultados han despertado gran interés en la creación de nuevos procedimientos basados en el principio de la destilación de los residuos bajo presión superatmosférica, es interesante conocer cuales son los fundamentos de la patente Burton. (*)

La patente Burton (patente de los Estados Unidos No. 1049667, junio 7 de 1913), ha sido transferida por su inven-

(*) Extracto de la patente. The Mineral Industry, 1912.

tor D. William M. Burton, gerente de la refinería de Whiting, Indiana, de la Standard Oil Co., a esta Compañía (*). La invención concierne al tratamiento de los resíduos de alto punto de hervir y particularmente los resíduos de la destilación del petróleo del grupo o serie de las parafinas; después los destilados de bajo punto de hervir producidos, son separados para obtener productos de la misma serie de bajo punto de hervir.

Como se sabe, los métodos de destilación del petróleo crudo, han sido perfeccionados en los últimos años para obtener la mayor cantidad posible de naftas. El punto de hervir de aquellas naftas o gasolinas, oscila entre 75° y 350° F. Ellas dejan petróleo iluminante, cuyo punto de hervir varía de 350° a 600° F., aceites lubrificantes y ceras, y como resíduo: aceites combustibles y los llamados "gas oil," cuyos puntos de herver varían de 600° a 700° F. Ahora bien, el procedimiento de obtene grasolina de esos resíduos por descenso del punto de hervir, tiende invariablamente a convertir la fórmula del grupo de las parafinas Cn Hn+2 al del grupo etilénico Cn H²n, lo que hace el producto inaceptable en e lcomercio por su mal olor. Con el procedimiento Burton los combustibles y gas oil, han sido tratados por destilación destructiva para obtese productos de bajo punto de hervir. Los vapores resultantes son conducidos a través d eun condensador por med de una cañería conectada con el alambique, llevando una válvula especial en la cañería para mantener la presión dentro del alambique. Los productos condensados con todo, se encuentran haber sido convertidos en el grupo etilénico.

El objeto de la invención de M. Burton, es tratar el resíduo del grupo de la parafina, de una manera tal que el producto resultante de bajo punto de hervir, sea de la misma serie de las parafinas, evitándose la serie de los etilenos. Esto lo verifica mediante la elevación del punto de hervir del resíduo líquido, por medio de la presión sostenida sobre el líquido y vapores, los cuales son mantenidos bajo presión en todo su curso desde el alambique, a través del condensador y mientras dura la condensación.

El aparato empleado consiste de un caldero equipado de una válvula de seguridad, hogar, válvula de presión y termómetros. Una tubería conduce desde el extremo superior del domo del caldero a un condensador consistente en un serpentín sumergido en un tanque refrigerador. Cerca de la extremidad más baja del serpentín, una pequeña cañería lleva una válvula de socorro y más bajo, cerca del suelo, conectado con un recibidor para los productos de condensación, hay una válvula de cierre (shut off valve). Esta válvula normalmente está cerrada. La válvula de socorro, permite el escape de todo exceso de gas superior a la presión. La presión con que el shut off valve está cerrada, es de 4 a 5 atmósferas, levantando el punto de hervir de 500° a 750° u 800° F. Esta presión combinada con la temperatura incrementa grandemente la conversión de los miembros de alto punto de hervir de la serie de las parafinas, en miembros de bajo punto de hervir de la misma serie. El inventor no explica las razones por las que la sobre presión sostenida produce tal resultado.

Los fundamentos declarados (Claims stated) de la invención, son los siguientes:

1o. El método de tratamiento de las porciones líquidas de la serie de las parafinas de la destilación del petróleo que tiene un punto de hervir por encima de 500° F., para obtener de ellos productos de bajo punto de hervir de la misma serie, lo cual consiste en la destilación a la temperatura aproximadamente desde 650° hasta próximamente 860° F., los productos volátiles, constituyentes de tales líquidos, conduciéndolos, condensándolos y manteniendo una presión próximamente entre 4 y 5 atmósferas sobre tales líquidos y tales vapores completamente en todo su curso y mientras dura la condensación."

2o. "El método de tratamiento de las porciones líquidas de la serie de las parafinas de la destilación del petróleo que tienen un punto de hervir por encima de 500°, para obtener de ellos productos de bajo hervir de la misma serie, lo cual consiste en la destilación a la temperatura aproximadamente desde 650 hasta próximamente 850° F., los productos volátiles constituyentes de tales líquidos, conduciéndolos y condensándolos y manteniendo una presión próximamente entre 4 y 5 atmósferas, sobre tales líquidos y tales vapores completamente en todo su curso y mientras dura la condensación y soltando de tiempo en tiempo, los gases acumulados de los productos de la condensación.

Como se ha dicho antes, el procedimiento de descomposición por destilación bajo presión, da lugar siempre a la formación de hidrocarburos no saturados y por consiguiente, productos de mal olor y lo mismo sucede con la aplicación del procedimiento Burton, cuyos productos no obstante las pretensiones del inventor, resultan de mal olor.

Sobre este punto llamaré la atención hacia el descubrimiento del Dr. Day, según el que, debiéndose el mal olor de las gasolinas a la deficiencia de hidrógeno en su composición, puede remediarse ello por la hidrogenación de las gasolinas mal olientes bajo la influencia de un agente catalítico.

Dicho descubrimiento que ha sido aplicado en escala industrial, constituye la patente Day en los Estados Unidos, tanto la primitiva bajo el No. 826,089 de julio 17 de 1905, como la nueva, referente a sus mejoras, inclusive el aparato con el No. 1004632 de octubre 3 de 1911. Dicha patente, en adición a la destilación bajo presión, incluye la hidrogenación y por consiguiente, la producción de productos aromáticos.

En ese procedimiento los vapores de los hidrocarburos son mezclados con gas hidrógeno y puestos en contacto con un agente catlítico conveniente. Con el fin de promover la combinación química del hidrógeno y de los hidrocarburos no saturados, por ese medio se cambian entonces ellos en productos saturados de la serie de las parafinas.

El método Day parece tener la ventaja de producir una gasolina de olor agradable y del mismo carácter y calidad que las obtenidas naturalmente en la primera destilación del petróleo crudo.

Los fundamentos declarados de la invención son los siguientes:

1o. La combinación de un alambique de petróleo con un hidrogenerador, comprendiendo dos cámaras de vapor y una cámara intermedia de petróleo; tubería que conecta las cámaras de vapor, la repartición entre la cámara de petróleo y una cámara de vapor, teniendo una abertura para el paso de los vapores a las tuberías y un cuello de ganso o cañería de escape de vapor, conectado con la otra cámara de vapor."

2o. La combinación en adición con una cañería principal de un generador de hidrógeno, gas o vapor conectado con la cámara de petróleo.

3. La combinación con la cañería de producción de hidrógeno y su adicional cañería de escape de vapor con las dos cámaras de vapor.

4o. La combinación de lo arriba mencionado, lon un generador para suplir gas caliente o vapor.

5. La combinación de lo arriba mencionado, de una válvula para controlar la presión y temperatura del hidrógeno y vapor de petróleo destilado en contacto con un contacto material."

(*) Recientemente ha sido patentado en Inglaterra el "Procedimiento de tratamiento de resíduos de la destilación del petróleo, a nombre de Harold Wade ("Standar Oil Company") No. 6593. Marzo 1914 y con el mismo objeto por la "Continental-Caotchouc and Guttapercha." No 7112. Marzo 1914.

Un Nuevo Procedimiento para el Temple.

Es el adoptado por casa Vickers y que permite obtener el temple, sólo en las partes deseadas, en un trozo de cualquier tamaño y de cualquier clase de acero. Se calienta rapidísimamente la parte a templar mediante una llama a gas y se enfría inmediatamente con agua, aceite, etc. El temple alcanza así cerca de 1,5 mm. de profundidad y prolongando el calentamiento, hasta cerca de 5 mm. Se tiene la ventaja de poder templar de diversos modos las distintas partes de un objeto, por ejemplo: los dientes de un engranaje.

Nuevas Hipótesis para Explicar las Causas de los Cambios Atmosféricos Durante los Periodos Geológicos.

El más conocido de estos cambios es la gran baja de temperatura a fines de la época pliocena y durante la primera parte de la epoca cuartaria, la época glacial.

Los geólogos han demostrado la gran extensión de las nieves eternas durante esa época, manifestada claramente por las morainas, que han dejado los antiguos ventisqueros en regiones donde actualmente reina un clima templado.

Menos conocido es tal vez que esta baja de temperatura fué precedida durante la época pliocena y todo el período terciario y secundario por un clima mucho más templado que el actual. Pruebas de esto tenemos en las regiones árticas en los numerosos restos de plantas subtropicales, que se encuentran en las capas sedimentarias de aquellas épocas y en las importantes capas de carbón de piedra existentes, tanto en la región ártica como en la antártica.

Menos conocido todavía será, que indiscutibles pruebas de otra época glacial se ha encontrado también en las capas pertenecientes al período paleozoico.

Para explicar estos hechos se han propuesto varias hipótesis o teorías. Mencionará algunas de ellas:

1.) Desde luego se ha creído que los cambios de temperatura pueden haber tenido su orígen en cambios geográficos y topográficos de la tierra. Mayor altura de los continentes causaría mayor extensión de las nieves eternas; cambios en la extensión y configuración de los contienentes podrían haber desviado las corrientes frías o calientes del mar, influenciando de esta manera la temperatura del aire y el clima local.

2.) El aumento de la actividad volcánica, que ha tenido lugar durante fines de la época terciaria, manifestada por las inmensas capas de lava y el gran número de volcanes apagados, debe haber sido acompañado por grandes emisiones gaseosas de ácido carbónico, que pueden haber formado una capa continua alrededor de toda la tierra. El efecto de esta capa sería suavizar la irradiación solar y disminuir la irradiación terrestre. modificando de esta manera el clima.

3.) El movimiento del eje de la tierra al rededor del eje de la elíptica tiene por consecuencia, que con intervalos, de 13,000 años el largo del verano se aumenta en 10 días en uno de los hemisferios, al mismo tiempo que el largo del invierno disminuye en el mismo número de días. Durante los 13,000 años siguientes sucederá lo contrario, es decir que aumentará el largo del invierno en 10 días, disminuyendo el largo del verano en el mismo número de días. Estos cambios se hacen en los dos hemisferios alternativamente. De esta manera variaría por cada uno de los hemisferios la cantidad de calor recibida del sol, variación que será más fuerte, cuando los veranos más largos coincidan con la distancia más próxima de la tierra al sol (el perihelio). Pero como esta variación del calor recibido no es simultánea en los dos hemisferios no explicaría el hecho de que la época glacial parece haber sido simultánea en ambos.

4.) También se ha emitido la hipótesis de que la inclinación del eje de la tierra dentro de ella misma ha variado durante las épocas geológicas.

Como ninguna de estas hipótesis ha sido considerada satisfactoria, algunos geológos han creido que quizás la cantidad de valor irradiado por el sol ha sido variable.

El infrascrito se permite someter a la consideración de los hombres científicos una nueva hipótesis y es la siguiente:

6.) No es la irradiación del sol la que ha variado, sino la distancia del sol a la tierra, que ha variado durante las épocas geológicas, por cuyo motivo la cantidad de calor recibida por la tierra desde el sol ha sido variable.

Para que la distancia de la tierra al sol haya variado, será necesario que la fuerza de atracción, la gravitación, haya variado.

Esto a primera vista parecerá un absurdo, puesto que la tracción, el peso de los cuerpos, generalmente se considera como una fuerza o calidad inseparable e inherente de la materia e invariable. Las observaciones astronómicas también indican que durante los cuatro o seis mil años en que se han hecho operaciones o estudios astronómicos, esta fuerza no ha variado. Sin embargo, seis mil años no son nada en comparación con las épocas geológicas y por otra parte hay motivo para creer que la atracción universal no es una fuerza que reside dentro de la materia, sino una fuerza que viene de afuera. Si esto fuera así, se comprenderá que no sería tan imposible que la gravitación fuera variable, tanto en el espacio como en el tiempo.

Hace tiempo que los físicos han comprendido lo poco probable para no decir imposible que es, que un cuerpo pueda obrar sobre otro a la distancia sin ninnún lazo intermediario.

Así como para explicar la trasmisión de la luz los físicos han tenido la necesidad de suponer la existencia de un éter, dotado de ciertas calidades y llenando todo el espacio, también algunos han creido que quizás este mismo éter se podría aprovechar para explicar la atracción universal (la gravitación) suponiendo en el éter una presión en todas direcciones. Un solo cuerpo dentro del éter sufriría esta presión con igual fuerz aen todas direcciones quedando inmóvil, mientras que en presencia de otro cuerpo los dos o protegerían mutuamente de una parte de la presión, resultando en la dirección de los dos cuerpos un exceso de presión, que los acercaría uno a otro con una fuerza que obraría según la ley de Newton. La gravitación no sería entonces nada más que un exceso de presión del éter en la dirección de los dos cuerpos.

Mi hipótesis quedaría entonces trasformada de la siguiente manera. La presión del éter ha variado durante las épocas geológicas.

Para motivar esta hipótesis tengo, pues:

1.—Su conveniencia para explicar los grandes cambios climatéricos durantet las épocas geológicas. Esta razón sería naturalmentet nula en el momento que los cambios climatéricos pudieran explicarse de una manera más fácil.

2.—No es probable que en nuestro universo, donde todo es moviento e inestabilidad, solo el éter formara una excepción.

3.—Si la presión del éter fuera el resultado o siquiera influenciado por los movimientos ondulatorios, movibles y estacionarios, que de los innumerables cuerpos celestes, luminosos o no, irradian y se reflejan por medio del éter en todo el espacio y en todas direcciones, es claro que la presión no puede ser constante, puesto que los cuerpos celestes no están distribuidos con igualdad en todo el espacio, así como la fuerza de irradiación de cada uno de ellos varía con el tiempo, apagándose unos, mientras que otros recién principian a irradiar.

Mencionaré, por último, los experimentos hidro-eléctricos del profesor Bjerknes de la universidad de Christianía en los años de 1870 y siguientes. Colocó en un estanque de agua dos pelotas de goma huecas. Por medio de bombas de aire las hizo dilatarse y achicarse centenares de veces por segundo, produciendo de esta manera olas móviles en el agua, las que reflejadas en las paredes del estanque formaban olas estacionarias, vibraciones. Modificando el número y la simultaneidad de estos cambios de volumen de las pelotas, puedo reproducir todos los fenómenos eléctricos de atracción y repulsión entre ellos. Podríamos comparar quizás las pelotas de Bjerknes con dos cuerpos celestes y las paredes del estanque con el infinito número de estrellas, que todos lados irradian y reflejan las irradiaciones de las

demás, formando en el éter, en lugar de en el agua, ondas estacionarias.

Según esta hipótesis habría estado la tierra más lejos del sol que ahora durante una parte del período paleozoico, más cerca durante todo el mesozoico y terciario y otra vez más lejos durante la época glacial. Sin embargo, quizás no será necesario suponer, que este alejamiento haya sido mucho mayor que ahora. Hay que recordar que, al principiar durante fines de la época pliocena la época glacial, los contienentes con la atmósfera y los mares hasta su mayor profundidad conservaban todavía una temperatura correspondiente a la distancia menor durante el período mesozoico y terciario. El enfriamiento de los mares progresaría más despacio que el de los continentes y de la atmósfera, de lo que resultaría, que la mayor evaporación, correspondiente a su mayor temperatura, ocasionaría una precipitación mucho mayor que antes. Suponiendo que de esta precipitación correspondiera el mismo porcentaje que antes a la nieve caída, ya por este motivo se iría acumulando en las altas cordilleras mayor cantidad; ;pero con la baja de la temperatura tendría que ir en aumento este porcentaje, creciendo así en mayor proporción la cantidad de nieve acamulada. Además la existencia misma de una capa de nieve de mayor extensión contribuiría aun más a la baja de temperatura; al mismo tiempo que la mayor cantidad de nublado debido a la mayor evaporación y condensación, impediría en alto grado el efecto de la irradiación solar.

Todas estas circunstancias continuarían hasta que los mares por el enfriamiento habrían tomado la temperatura correspondiente a la nueva distancia del sal. A medida que se iba acercando este caso, disminuiría la precipitación y la cantidad de nieve caída, y con la menor cantidad de nubes obraría la irradiación directa del sol durante los veranos con más fuerza, deshaciendo la nieve y reduciendo su estensión quizás hasta sus límites actuales.

Tendríamos entonces la paradoja que el exceso de temperatura de los mares sobre la de los continentes habría sido la causa de que la extension de las nieves durante la época glacial fuese mayor que ahora.

Si después la tierra volviera a acercarse otra vez al sol, sucedería todo lo contrario de lo que sucedió durante el alejamiento.

Una gran parte de la mayor cantidad de calor recibido se emplearía en elevar la temperatura de los mares en lugar de producir una mayor eveporación, que sin embargo iría aumentando poco a poco. La temperatura de los continentes y de la atmósfera crecerían más ligero y resultarían una disminución de la humedad relativa de la atmósfera y una menor cantidad de agua caída, es decir, un clima más seco (es efectivamente lo que parece haber sucedido al final de la época glacial.)

A medida que la temperatura de los mares llegase a la que correspondería a la nueva distancia ,del sol, aumentaría la evaporación y la humedad relativa de la atmósfera y por consiguiente las precipitaciones acuosas, hasta llegar a su máximum cuando cese el acercamiento.

Durante el acercamiento reinaría un clima relativamente seco; durante el alejamiento, un clima más humedo.

LORENZO SUNDT,

Ingeniero de minas.

Informe Relativo a la Exploración de la Región Norte de la Costa Occidental de la Baja California.

En Sep tiembre de 1911 nos fué encomendado por la Dirección del Instituto Geológico Nacional, el estudio de los recursos naturales y de la geología de cierta zona en el Territorio de la Baja California. Esta comprendía una faja de un ancho hasta de 40 kilómetros, siguendo la costa del Pacífico, comenzando por el Norte en la línea de la frontera con la Alta California y terminando al Sur cerca del paralelo 30°. Una orden posterior añadió al estudio de la referida zona el de las salinas de Ojo de Liebre que se encuentran entre los paralelos 27° y 28° N. Esto nos proporcionó la ocasión de poder estudiar también las condiciones más al Sur. También en esta última expedición hemos seguido estudiando la zona de la costa durante el viaje de ida, pero a la vuelta hemos aprovechado la ocasión para reconocer también el interior de esa parte de la Península. Así pues, nuestros estudios se refieren a una faja entre el paralelo 32° 31′ 59″ N. y aproximadamente el paralelo 27° 40′.

Según el programa indicado arriba, teníamos que hacer por una parte observaciones puramente científicas acerca de la geología de la región para obtener así la base necesaria para la segunda parte de nuestras observaciones que se refiren a la geología económica, y en lo general a los recursos naturales del suelo de la Península. Así es que también nuestro informe tiene que subdividirse en dos partes diferentes: una que se refiere a las condiciones geológicas y otra que indica los recursos naturales que se encuentran en la zona que hemos estudiado. Esta última parte es la que damos en las páginas siguientes.

Nuestras observaciones acerca de las condiciones económicas de los recursos naturales de nuestra zona, no se refieren solamente a las que están en conexión directa con la geología, sino también a las que sólo de una manera indirecta están relacionadas con esta ciencia; es decir, que durante nuestro viaje, relativamente rápido, hemos tomado en consideración todos los recursos naturales de aquella región en el sentido más amplio de la palabra.

En el presente informe no vamos a tratar de las condiciones geológicas de la zona estudiada de una manera detallada, pero sí debemos dar a lo menos una reseña de lo orografía, la hidrografía, el desarrollo de las costas y el clima de la Península, pues estos factores constituyen la base para las posibilidades de la evolución económica de un país. Respecto a la geología damos principalmente los datos que son de importancia para la explotación del suelo, es decir, para la minería, la agricultura y la ganadería, de cuyas posibilidades nos ocuparemos de una manera más extensa. No dejaremos de mencionar nuestras observaciones acerca de la caza y de la pescadería; la última por lo menos hace un papel bastante importante en las condiciones económicas de la Península.

Los recursos naturales de la Península no han podido utilizarse en lo pasado principalmente a causa de la escasez de habitantes; ésta a su vez está en relación íntima con la falta de vías de comunicación. En consideración a esta circunstancia hemos dirigido nuestra atención también a las posibilidades del desarrollo de las vías de comunicación naturales y de la colonización del país. Una vez desarrolladas las comunicaciones y el país habitado de una manera más densa, se utilizarán también fácilmente los enormes recursos naturalesturales, no solametne en el adelanto de la minería y la agricultura, sino también en el desarrollo de la industria y del comercio.

Condiciones orográficas de la zona estudiada.

La zona a lo largo de la costa del Pacífico de Baja California se compone de tres elementos orográficos principales, a saber: de la llanura de la costa, de las meses y de sierras. Estos tres elementos no forman de ninguna manera una sucesión regular, de modo, por ejemplo, que la llanura se extiende a lo largo de la orilla del mar, que más tierra adentro sigan las mesas y en el ininterior las sierras, sino esta sucesión regular se observa únicamente en el orden de las llanuras y de las mesas. y esto sólo hasta cierto grado, mientras que las sierras atraviesan nuestra zona oblicuamente y sus extremos llegan con frecuencia hasta la orilla del mar. Así, encontramos al Norte del valle de Ensenada una sierra que se desprende de las grandes masas interiores y que en su extremo forma un promontorio, el Cerro del Vigía, y más al Norte otro, el Morro. Al Sur de la bahía de Ense-

nada o bahia de Todos Santos, encontramos otra sierra de dirección oblicua que se desprende en el interior de la montaña principal y que forma la larga y extensa península de Punta Banda. Otra sierra oblicua acompaña al lado meridional del valle de Santo Tomás terminando con promontorios fragosos cerca de la desembocadura del mencionado valle.

En el tramo al Norte de la Ensenada de Todos Santos se encuentran cerca de la costa apenas llanos de alguna extensión; en lo general se aproximan las mesas mucho a la orilla del mar, formando pendientes abruptas separadas del mar únicamentet por una playa angosta. Se encuentran allí llanos donde las mesas bajan en escalones hacia el mar y donde el último escalón se eleva poco sobre el nivel del agua o se han producido hondas cañadas en las mesas cuyo fondo ha llegado casi al nive ldel mar. Las mesas cerca de la costa ya no conservan realmente el carácter de altiplanicies, habiendo sido cortadas por barrancas de mayor o menor profundidad, hasta tal grado que hoy forman un sinnúmero de agudos cuchillos, que sólo por la altura uniforme de sus crestas conservan en algo el carácter de una mesa. Más hacia el interior se encuentran tambéin en esta región verdaderas mesas de diferente altura, pero separadas por cañadas y barrancas de laderas abruptas y de profundidad considerable. Hacia el interior, pero a distancia muy variable de la costa, emergen de estas vastas mesas fragosos cerros y sierras principalmente compuestos de rocas cristalinas que todavía más hacia el centro se juntan en una especie de sierra madre que forma el espinazo de la Península.

Cerca de Ensenada se ensanchan algo los llanos de la costa interrumpidos por las mencionadas sierras oblicuas al Nortet y al Sur de la bahía. Al Sur de la desembocadura del valle de Santo Tomás llegan las sierras fragosas hasta el mar, mientras que mesas casi faltan por completo. Cerca de San Isidro del Mar, las mesas comienzan de nuevo a extenderse, formando enormes planicies entre San Antonio del Mar y San Ramón. Estas mesas son de poca altura y llegan cas hasta la orilla del mar, de modo que se asemejan a verdaderas llanuras de la costa. Hacia el interior se levantan de estas mesas extensas sierras, principalmente compuestas de pórfido y otras rocas cristalinas que por su dirección oblicua permiten a las mesas ensancharse poco a poco hacia el Sur. Entre San Ramón y el rancho del Socorro, es decir ,en los alrededores de San Quintín, las mesas forman sólo una faja angosta de rocas cristalinas pegada a las sierras, mientras que entre ellas y la orilla del mar se extienden amplias llanuras que apenas se levantan sobre el nivel del mar.

Cerca de San Quintín un nuevo elemento topográfico le da al paisaje un carácter muy especial; nos referimos a los volcanes y corrientes de lava muy modernos que se encuentran cerca de la orilla del mar. Estos volcanes forman cerros en parte perfectamente cónicos, peñascos de lava, amplios cráteres, etc. Uno de los cráteres forma la isla de San Martín frente a San Quintín.

Desde el Socorro la llanura de la costa se angosta paulatinamente hacia el Sur, Esta llanura está formada por una mesa de poca altura; al Este de ella se levantan mesas de altura bastante considerable, que se ensanchan rápidamente hacia el Sur y el Este. Las serranías de contornos bruscos compuestas de rocas cristalinas se encuentran bastante hacia el interior, de modo que la región de las mesas alcanzan un ancho considerable. ,

Desde el Rosario desaparecen las llanuras de la costa y las altas mesas terminan en la orilla del mar en acantilados perpendiculares. Estas condiciones continúan hacia el valle de Santa Catarina. Desde este punto las mesas ya no forman una gran mesa más o menos continua sino están interrumpidas por amplios valles. de modo que más bien se observan cerros con una cima plana que mesas. Al Sur de la Punta de Canoas desaparecen las mesas por completo y los cerros formados por rocas cristalinas llegan hasta la orilla del mar. Debido a una antigua abrasión del mar, estas sierras tienden a formar también regionalmente mesas más o menos prefectas; a esto contribuye, además, la existencia de grandes corrientes de lava y depósitos de arenas y areniscas terciarias que comienzan aquí a cubrir las rocas cristalinas más antiguas.

Desde la desembocadura del río de San Xavier, se retira la montaña de la costa y empieza a extenderse a lo largo del Pacífico un enorme llano que se levanta muy poco sobre el nivel del mar. Este llano se ensancha rápidamente desde la desembocadura del río de San Xavier para alcanzar al Sur de Ojo de Liebre un ancho de más de 100 kilómetros.

En toda la zona estudiada de la costa del Pacífico se halla una serie de médanos. En donde no existen llanuras de la costa muy extensa ,estos médanos son angostos y de poca importancia, mientras que en donde hay amplios llanos que acompañan a la orilla del mar, los médanos se ensanchan y cubren a veces bastante terreno, extendiéndose por varios kilómetros de tierra adentro.

En el Norte la zona estudiada por nosotros no comprende el interior de la Península, pero en la parte meridional, al Sur de El Rosario, hemos tenido la oportunidad de entrar varias veces en el interior y hasta atravesar la sierra principal. Creemos, pues oportuno, dar unos datos también acerca de estas regiones. En el Sur, es decir, al Norte de Campo Alemán y Calamahí, se levanta la sierra bruscamente de los llanos; tanto en su lado occidental como en altura. Cerca de la antigua misión de San Fernando, al Este de El Rosario, se encuentran extensas altiplanicies en el interior de la Península.

CONTINUARA.

Apuntes Históricos.

Las tradiciones de las minas de la Freden Copper Company datan del siglo XVIII, en que un Teniente del Ejército español, huyendo de la justicia escapó hacia la Cordillera, como se llama a los nevados Andes entre Chile y la Argentina, donde acampó en el paraje que después fué conocido con el nombre de "El Mineral del Teniente." Se dice que este individuo descubrió allí una veta de mineral de alta ley, y, que de lo que produjeron las remesas que del mismo hizo, pagó la multa a las autoridades, quienes lo exoneraron de mayores dificultades con el Gobierno Colonial.

Sea como sea, lo cierto es que el primer dato oficial data de 1819, año en que don Juan de Dios Correa, Conde de la Conquista, y poseedor de la inmensa hacienda que se extiende desde la falda Oeste de los Andes chilenos hasta los límites con la Argentina, y dentro de la cual están situadas las minas, tomó a su cargo la explotación. Don Juan de Dios benefició las minas hasta los años setenta del pasado siglo, transportando la piedra mineral hasta la costa, a lomo de mula, para exportarla.

Por aquel tiempo se hizo admisión de socios para la Empresa, y uno de ellos, don Federico Gana, graduado en Freiberg, la tomó a su cargo. El abrió lo qe ahora se conoce como Socavón No. 1, para de allí perforar el cuerpo de la veta qe hasta entonces sólo había sido atacada por laboreos al sesgo, irregulares, hechos de la superficie. Desde este Socavón se hundió un pique hasta una profundidad de más de 100 metros y se instaló un malacate en un caserón, a la entrada. Una corredera de madera (canal) inclinada, conducía al mineral montaña abajo hasta un punto situado cerca de las lagunas o pequeños lagos que hay al pie de los cerros, donde se hacía la palladura, y en los Perales, a más o menos 15 millas de distancia, cerca de la confluencia del Coya con el Cachapoal, se instaló una fundición. En resumen, se levantó lo que por aquel entonces se consideraba ser una planta de explotación a la moderna.

Debido a las fuertes nevazones en las minas, no se hacía trabajo alguno en los meses del invierno, a excepción del desagüe del pique y la preparación de la mina para la extracción del mineral de alta ley en la siguiente temporada de trabajo.

Según las cuentas de laboreos de aquellos tiempos, durante un invierno el capataz y los mineros se robaron casi todas las herramientas y equipo desmon-

*Escrito por Mr. Wm. Brader, en Teniente Topics.

table, de modo que en la primavera siguiente, los dueños hallaorn el pique lleno de agua. Otra versión dice que de pronto se encontró agua, y que aquellos mineros que estaban en las labores más bajas tuvieron escasamente tiempo para escapar, tal era la rapidez con que subía el agua. De todos modos el dinero se hizo entonces necesario para poner las minas en estado de aprovechamiento, y como no se pudo obtener se abandonó, y se dejaron de pagar las patentes.

Allá por el año de 1897, don Enrique Concha y Toro, capitalista minero muy emprendedor, mandó un cateador a ese distrito, y después de hacer pedimentos que abarcaban algunos de los criaderos demayores expectativas, incluso la antigua mina "Teniente," procedió a pallar el mineral de alta ley procedente de los cortes en esta última, y a venderlo.

Don Carlos Irarrázaval, casado con doña Nicolasa Correa, heredera de don Juan de Dios Correa, de quien antes se ha hecho mención, entabló juicio en resguardo de los intereses de la Hacienda de Correa, para prescribir a don Enrique Concha y Toro. Las dificultades entre ambas partes se finiquitaron después de cierta lucha judicial, por medio de un arreglo según el cual don Enrique Concha y Toro sólo quedaba dueño de una tercera parte de la mina "Teniente," yse le reconocía la propiedad plena a todos los demás pedimentos que él había hecho allí; por otra parte, los herederos de Correa no invertirían capital en el negocio. En vista de esto, el señor Concha, no qeriendo trabajar para beneficio de otros en la mina "Teniente," en la que sus socios tenían derecho a dos terceras partes, se limitó a buscar mineral en aquella parte de buscar mineral en aquella parte de la pertenencia de la cual él era el único duuño. Fué así como la exploró la "Capitana" y la "Subteniente," pero principalmente las minas "Fortunas," donde realizó extensos laboreos subterráneos en una extensión de más de 100 por 150 pies y alcanzó una profundidad de más de 150 pies, siempre a la expectativa del mineral para la exportación. No pudo hallarlo, ya que las vetas de valor se encuentran allí en fracturas, o bien, diseminadas en una conformación dioritica que sólo produce un mineral de 4 por ciento de ley, por lo cual, se hacía necesaria una concentración en escala más o menos importante para que pudiera ser remunerativa su explotación.

En estas circunstancias se consultó a don Marcos Chiapponi, ingeniero de Minas Italiano, sobre lo que convenía hacer con la pertenencia, y él recomendó la construcción de una planta de concentración. Como una instalación de esa naturaleza, con camino carretero apropiado, planta de fuerza y demás equipo, requería más capital que el que el señor Concha estaba dispuesto a invertir en lo que se consideraba una mina de baja ley, se comisionó al señor Chiapponi para la venta de la pertenencia.

El señor Chiapponi remitió cerca de 25 toneladas de mineral a Europa para hacer experimentos de concentración, y habiendo dado buenos resultados, ofreció el negocio a los capitalistas de Francia e Inglaterra, de donde viniero ningenieros a examinar las minas; pero aparentemente, no fueron capaces de comprender la magnitud del negocio, que, además, era en ese tiempo nuevo en su clase, por lo que informaron desfavorablemente.

Dos años después, el señor Chiapponi propuso el negocio al que subscribe, quien, después de una cuidadosa inspección se formó una opinión favorable del negocio e interesó a su amigo Mr. E. W. Nash (Q. E. P. D.) entonces presidente de la American Smelter & Refinin Company, y uno de los expertos mineros más emperndedores de los Estados Unidos, para la organización de la Braden Copper Company, con el objeto de explotar la pertenencia con un capital de 625 mil dólares.

Con este dinero se pensaba abrir y equipar las minas; tender un camino carretero de cerca de 25 millas de largo para ponerlas en comunicación con Graneros, estación en la línea del ferrocarril del Estado, a 1,600 pies de altura sobre el nivel del mar, o sean a unos 6,00 pies bajo el nivel de la mina; levantar un molino de concentración con capacidad para 250 toneladas diarias; construir tres andariveles; instalar una planta hidroeléctrica de unos 1,000 HP. de desarrollo aproximadamente; y proporcionar habitaciones tanto en la mina como en el campamento del Molino.

No obstante ser esta Empresa la primera en su género que se establecía en los Andes chilenos, en condiciones poco conocidas, el subscripto y su cuerpo de empleados terminaron con gran satisfacción la construcción de la planta con sólo el capital asignado primitivamente para tal efecto, dando principio a las faenas de concentración en el mes de junio de 1906, dentro del tiempo señalado para iniciar la explotación.

La ruta corriente, antiguamente, para llegar a las minas, era por un sendero que partiendo de Rancagua pasaba por el villorio de Machalí, distante cerca de 45 millas, y atravesando el rancho de la Isla, seguía por la ribera sur del río Coya.

En la pertenencia no habían más casas que un par de rucas—chozas pequeñas y bajas, con paredes de piedras superpuestas y techo de hojas sueltas de fierro acanalado que se mantienen en su lugar mediante el peso de algunos peñascos artificiosamente esparcidos sobre ellas. El techo de la ruca que hacía las veces de comedor estaba cubierto de ramas verdes, traídas del bosque cercano, lo que era causa de inquietudes para los comensales, pues los burros del campamento gustaban de pastar en ellas—hazaña que se facilitaba debido a que la ruca se afianzaba por la parte de atrás contra el cerro, de tal manera que la culata del techo quedaba a nivel de tierra.

El camino carretero desde Graneros fué terminado en 1905.

Durante los meses de invierno de aquel año (junio, julio, agosto) se acumularon en la estación de La Compañía, próxima a Graneros, cerca de 4,000 toneladas de maquinaría y materiales de construcción para ser transportados a la mina. Ciertamente, al mirarlo, aquello parecía una tarea enorme. Algunos caballeros chilenos emitieron la opinión de que serían necesarios de tres a cuatro años par acarrear ese material hasta la Cordillera, así que cuando se les dijo que la Compañía no sólo se proponia acarrear ese material, sino también terminar la planta y hacerla funcionar en el siguiente junio, su incredulidad llegó a la irrisón. Sin embargo, las expectativas de la Compañía, a fuerza de energía y perseverancias, se realizaron. En una ocasión se pudieron contar hasta 250 carretas en el trabajo, lo que significaba el empleo de más de 2,000 animales. Estas carretas trabajaban en las haciendas circunvecinas, y sólo se logró inducir a los carretoneros a dejar sus habituales contornos en las charcas y trigales de los valles para acarrear pesadas cargas hasta la Cordillera, pagándoles, lo que en aquel entonces se consideraba un alto precio de flete,.... $25.00 papel por tonelada, o sean unos $7.50 dólares, al cambio de entonces. En verdad, muchos acudieron prontamente al llamado. Se publicaron avisos en los diarios, y se fijaron otros en los distritos agrícolas, invitándolos a venir, a venir a todos!

Cerca de un millar de criollos se ocuparon en los trabajos de construcción en el campamento, durante la estación de invierno de 1905-1906, es decir, desde septiembre a mayo, inclusive. En los primeros meses no tenían casas, así que cuando algún grupo de trabajadores se presentaba demandando trabajo,, se le daban unas cuantas hojas de fierro acanalado y pronto ellos mismos se construían su ruca. Algunos trabajadores se hacían ellos mismos s ucomida, apesar de que la Compañía mantenía cantinas en carpas, en donde la mayoría de los trabajadores podían tomar sus alimentos

El trabajo se realizó, y en verdad fué posible, sólo en pugna con las costumbres del país. Estas, a más de un consumo inmoderado de licor y la observación de innumerables días de fiesta durante el año, sin contar los domingos, constituían necesariamente un daño con el qe era imposible lidiar. Se prohibió, pues, la entrada de licor al campamento, y gradualmente se consiguió suprimirlo por completo, aprendiendo los hombres de ese modo, a trabajar en los días de fiesta en lugar de haraganear.

El trabajo, hombre por hombre, era más barato que en los Estados Unidos,

y bajo una dirección eficiente, obtuvimos del trabajador chileno, peso por peso, tanto como se puede obtener del trabajador de la América del Norte.

Durante el período de construcción, el trabajo se realizó con toda felicidad. Los hombres eran bien tratados por sus jefes, quienes estaban constantemente "al pie del cañón," y daban así el ejemplo a los peones que lo aprovechaban, demostrándolo con su puntualidad, constancia y perseverancia.

La construcción del Molino le fué encomendada a Mr. W. E. Bradley, de la planta de fuerza se hizo cargo Mr. E. Doolittle, los andariveles fueron construídos por Thomas Graham, y la apertura de la mina se le dió a Mr. Thomas M. Hamilton.

Las faenas mineras con completamente diferentes a las que los criollos estaban acostumbrados, y al principio, no hay duda, las encontraban pesadas; pero el ejemplo que Mr. Hamilton les daba, mostrándoles una energía inagotable a la par que un carácter jovial, conquistaban a los trabajadores, aliviando cualquier resentimiento justo. También les daba pacientemente lecciones objetivas sobre el empleo correcto de las herramientas y manejo de los explosivos, con lo cual ellos sacaban de sus contratos mejores ventajas y alegremente recogían una copiosa cosecha de utilidades.

Aunque había cierto peligro en el trabajo, mucho del cual se hacían en las escarpadas pendientes de las nevadas y ásperas montañas, y se movilizaban pesados cuartones de madera para las torres de los andariveles y demás trabajos, por partes donde se creía que no había espacio ni para el pie de un hombre, no ocurrieron accidentes que acasionaran pérdidas de vidas durante el período de construcción. El primer accidente fatal que ocurrió en el campamento tuvo lugar poco después de terminadas las construcciones, y cuando ya se había dado principio a las operaciones de concentración. Se produjo en el portal de la antigua mina "Teniente," donde un minero, contraviniendo los reglamentos de la Compañía, y obrando en una forma muy en uso entre los criollos de los Andes, trató de deshelar unos 46 cartuchos de dinamita, en una pala, columpiándola suavemente sobre las llamas de una viva fogata que ardía en un brasero de dos pies de diámetro. De una u otra manera los mineros de estos contornos logran efectuar estas hazañas impunemente una y otra vez, hasta que concluyen por cenvencerse de que es la manera más sabia de salir del apuro. Sin embargo, en esta ocasión no se realizó impunemente. Por fortuna, no había más gente allí que el minero que tenía la pala por el mango y su ayudante que estaba al frente. Extraño es decirlo, aunque ambos estaban a igual distancia del explosivo, sólo murió el ayudante, el minero escapó indemne, molestado sólo por una sordera de varios días.

Durante el período en que la fiebre de construcción se hallaba en su auge, había considerable rivalidad entre los jefes, cada uno de los cuales competía con los demás en vigoroso esfuerzo para completar primero su parte de trabajo.

De vez en cuando algún accidente venía a distraer al campamento, causando hilaridad o disturbios. Un día, mientras se hacía volar la roca para acomodarle cama a la acequia del "Teniente" en la falda del cerro, y casi encima de la línea señalada para el andarivel, la roca disparada destruyó completamente tres de las torres del andarivel; el Superintendente que estaba a cargo de la construcción del andarivel y que se congratulaba por la rapidez con que progresaba en su trabajo, se disgustó hasta tal punto que no había medio de convencerlo de que el tiro no se había disparado expresamente para tumbarle sus torres y retardarle su trabajo.

En 1905 se consiguió, a costa de grandes dificultades, que unos 50 hombres se quedaran a invernar en el campamento. Realizado este intento antes de que principiara el invierno del año siguiente, ya se habían levantado tarimones y casa-habitaciones para algunos centenares de obreros. Como aliciente para conseguir que los trabajadores se apegaran a sus labores, se estableció que cada hombre que trabajara desde el mes de mayo hasta el de septiembre recibiría gratis un número para una lotería que se inició en el campamento con premios de 100 a 500 pesos, más algunos premios para perdedores. Este sistema tuvo éxito durante varios años asegurándose d ese modo, un personal completo de trabajadores.

Mientras los trabajos de construcción seguían adelante en el campamento, se hacían las mensuras necesarias para la construcción del ferrocarril que uniría las minas con Rancagua, estación en la línea del ferrocarril del Estado; y casi con la misma rapidez con que se levantaban los planos se iba tendiendo la trocha. Este trabajo se hizo al principio bajo la dirección de Mr. Titus, pero después fué tomado por Mr. Geo. E. Montandon, quien en las regiones rocosas de la cordillera, hubo de salvar numerosas dificultades, ya que la línea asciende desde 480 metros sobre el nivel del mar, altura de la primera estación de término proyectada, con gradientes máximas de 4.5 por ciento y una curvatura, debida a la topografía del terreno, que hace la trocha de un largo de 70 kilómetros, a pesar que la distancia en línea recta entre ambas estaciones de término es sólo de 35 kilómetros.

Cuando a causa del terremoto de 1906 se desmoralizó el servicio de los ferrocarriles del Estado, se pensó que sería de utilidad para la Braden Copper Company poseer medios propios de transporte hasta la costa. Con esa mira, y después de un reconocimiento por tierra, decidió la Compañía ver si el río Cachapoal era navegable hasta la costa por vaporcitos de rueda de poco calado, tal como los que surcan las partes superiores de los ríos Columbia y Kootenay al noreste de los Estados Unidos.

Un bote, ideado por Mr. Montandon, y contsruído en la mina, fué transportado hasta Rancagua, lanzado al río, y bautizado con el nombre de "Esperanza." La noticia de la proyectada excursión trascendió a unos pocos; así fué cuando un día Mr. Montandon y el que subscribe estivaron sus paquetes en el bote, una gran cantidad de vecinos de Rancagua se agrupaban en la orilla esperando vernos naufragar. Sin embargo, se quedaron estupefactos al ver el bote deslizarse suavemente río abajo arrastrado por la rápida corriente. Las aventuras del viaje fueron diversas, y más o menos interesantes. Basta decir que navegamos en el río hasta unas 12 o 14 millas antes de la costa, es decir, hasta la confluencia del Cachapoal con el Rapel, donde nos convencimos que la navegación por el río era impracticable desde el punto de vista comercial, por cuya razón se abandonaron posteriores exploraciones.

Si, en el futuro, alguien tiene interés en continuar estas exploraciones deberá tener presente que para ello se necesitn conocimintos técnicos en cuestión corrientes de ríos, raudales y caídas. Montendon poseía tales conocimientos en grado superlativo, de lo contrario, es probable que yo no estaría escribiendo este artículo.

Referente a los primeros tiempos de apertura, organización de trabajo, y allanamiento de dificultades, recuerdo con agradecimiento la incansable ayuda y lealtad de todo el personal, muchos de los cuales, hoy, diez años más tarde, aún trabajan a mi lado.

La Metalurgia del Cobre en 1914.

Continuación.

Están en progreso las experiencias que se efectúan sobre las posibilidades de la separación mecánica de estas partículas sólidas. Un modo de escape sería generar el vapor en una cubeta separada, encerrada en el caldero principal. Este podría también operar turbinas que trabajen con una presión exterior, ligeramente inferior a la atmosférica y así evitar la necesidad de cerrar con trampas, las aberturas del caldero primario. Una conclusión semejante ha sido obtenida con los experimentos ingleses sobre escorias de fierro. No hay razón para que un procedimiento semejante, no pudiera ser aplicado a las escorias de los reverberos.

La "Detroit Copper Mining Co.," ha erigido en Morenci un horno de cuba de 44x396 pulgadas para tratamiento a baja presión de viento, de una carga que consiste principalmente de concentrados, que por lo general, sería considerada como una cuestión para reverberos.

Convertidores.

La práctica en los convertidores básicos, está ahora controlada y desde que ha quedado generalmente comprendido que la durabilidad de un revestimiento básico, depende del mantenimiento de una capa protectora de magnetita, se obtiene prácticamente tonelajes ilimitados con un simple revestimiento. Los dispositivos verticales continúan siendo usados en las nuevas instalaciones, de preferencia al tipo horizontal.

Condensación de humos.

Se está haciendo gran esfuerzo en el campo relativo a la eliminación de los perjuicios de los humos de fundición; tal vez los mayores progresos están en la línea de la precipitación electrostática. Prácticamente, todas las nuevas instalaciones de humos están equipadas con alambres suspendidos para recoger la masa de los sólidos. La casa de sacos puede ser adoptada para recoger el total de los sólidos restantes, pero el alto costo de instalación, agregado al de los agentes neutralizantes para proteger los sacos, han militado contra su uso, donde la acidez, muy variable, tiene que estar en su contacto, como en el caso de los gases de los convertidores de cobre. En Garfield, se han efectuado unas series de experimentos de absorción con el sistema Cottrell y en la nueva extensión de los flues, se ha introducido una parte para tratar todos los humos del convertidor. Se ha desarrollado un nuevo tipo de tubo electrodo y parece practicable la eliminación de más del 95 por 100, en promedio, de los gases. También se han obtenido resultados prometedores en la precipitación fraccionaria de diferentes impurezas, mediante tratadores en series con descenso apropiados de temperatura. En Anaconda, se progresa en los experimentos para desarrollar un tipo más barato de la instalación Cottrell, usando tubos más grandes para los electrodos.

Los experimentos que se llevan a cabo en Coram, California, sobre el procedimiento Hall, para el tostado de sulfuros, con productor de gas o aceite combustible, con la consiguiente recuperación de azufre elemental y la correspondiente eliminación de gas sulfuroso de los homos, han sido muy interesantes. Desgraciadamente, la guerra puso fin a los experimentos, justamente cuando se obtenían esultados muy prometedores.

Indirectamente la lixiviación de los relaves de concentración y la utilización puede considerarse como una contribucentrados en la electrólisis subsiguiente, del gas sulfuroso del tostado de los conción hacia la condensación de humos.

Refinado.

Se está dando actualmente considerable atención, al perfeccionamiento de los dispositivos de los hornos de refinado. Para fundir material muy impuro con producción de ánodos de alta ley, los hornos básibos de Chrome parecen haber justificado ampliamente su mayor costo de instalación. Las demandas hechas de ladrillos básicos, están resultando favorables al perfeccionamiento en su calidad. Es entendido que por lo menos, uno de los grandes manufactureros está instalando maquinaria para omoldar planchas de magnesita bajo alta presión, de cuerdo con la práctica extranjera. También es de esperarse que se desarrollarán convenientes fuentes privadas de magnesita, de manera a bajar el costo todavía relativamente clevado de ese ladrillo.

Se están construyendo hornos más angostos y más largos para fundir cátodos. La refinería de Baltimore tiene un horno de 14 pies 6 pulgadas por 48 pies, y l ainstalación de Chrome ha terminado precisamente uno de 13 pies 11 pulgadas por 40 pies. En el horno más estrecho, es más fácil controlar las reparaciones del piso, que son siempre mayores que en los reverberos de fundición, debido esto a la operación cíclica en vez de continua, con los consiguientes cambios de temperatura. Hace varios años, se ensayó en la "Michigan Smelting Co.", hornos más largos, pro como estos fueron acortados después de una prueba, el desarrollo en este sentido fu½ un fiasco. Parece que dificultades de otro orden, fueron aplicadas injustamente a la longitud del horno. El nuevo horno de Chrome, tiene un fondo de arena, muros laterales de ladrillos chrome y techos de ladrillos de sílice. El consumo indicado de carbón parece ser de cerca de 10 por 100.

Se han obtenido algunos excelentes resultados en las recientes instalaciones de calderos calentados por el calor perdido en la refinería de Chrome. Calderos del tipo B. & W. seguidos de economizadores, han dado evaporaciones equivalentes entre seis y siete libras, y se cree que con algunos cambios, un caldero limpio dará ocho libras. Se alimenta agua fría en el economizador y parte de la alimentación que sale del economizador, regresa al lado de entrada por medio de una pequeña centrífuga. Esto previene los escapes y la corrosión.

El problema es más difícil que una práctica de fundición, pues hay una mayor escala de capacidad que hay que tener en cuenta, debida también a la operación cíclica del horno, aunque modernos métodos de recarga están disminuyendo al mínimo estas diferencias. Hay una ventaja adicional y es que, cuanto más rico en materias bituminosas es el carbón que se quema en el horno de refinado, se quema en los calderos de las refinerías de la costa del Atlántico, un tamaño mucho más barato de antracitas y esto baja el costo del vapor con el que debe competir el vapor calentado por el calor perdido, y de aquí el valor del vapor producido por el calor perdido.

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Getting Back to Work.

If the resumption of mining in this country is to be delayed it will not be for lack of effort on the part of those most interested. From all sides come reports of preparations for getting back to work. The smelters are working tooth and nail to get their plants in operation and are behaving precisely as though they expected to succeed, hands down. If the smelters succeed in their efforts, all the other mining companies will be able to resume at once, for the smelters need rail transportation more than those engaged in other branches of the industry. A smelting works requires a constant supply of coke and ore and these must be furnished by the trainload, while a cyanide mill needs only an occasional car-load of supplies. If the smelters can run, so can almost every mine in the country, except those in districts where order has not been fully restored, which are dwindling in number every day.

Evidences of restored confidence and determination to avoid all possible delay are appearing daily. The enterprise of the Real del Monte company in chartering a train to bring down supplies from the border and carry back a shipment of concentrates, assuming all possible risks, has not received the publicity it deserves. Evidently there is no lack of confidence in that direction. The companies operating in Matehuala and in Wadley, San Luis Potosi, are showing equal enterprise. They are organizing their operating forces quite as though they were assured of normal train service next week.

Another evidence of returned confidence and activity is the fact that large mercantile houses in Mexico City and other large centers are ordering goods from abroad. The cash orders that have recently gone forth have been of sufficient volume to affect the rate of exchange.

All of which goes to show a confidence in the future such as has not been in evidence for months, and an increasing pressure for rail transportation which, if continued, will in the natural course of events remove the only obstacle to a prompt general resumption of mining throughout the country.

More Mexican Camps to Resume Mining.

Late reports from the border state that Sonora has been so far pacified that the Cananea Consolidated Copper Co. officials have ordered the employes of the company to report for duty, and that a full force of men has been taken in on a special train. Since it is generally believed that the resumption of mining will begin in the north and proceed southward, this start in the stronghold of opposition is significant. Operators in the El Oro district are also beginning to show renewed activity, and plans are under way to clear the southern part of this State of scattered bands of marauders, so that the mines in the Zacualpam district may get back to normal conditions.

The Future of Copper.

Reports that copper has again risen above the twenty-cent mark bears out the predictions of the experts of some months ago. The war demands for the metal are still enormous, and already anxiety as to supplies for industrial purposes after the ammunition makers have finished their contracts is beginning to appear. It is reported from a reliable source that contracts, mounting into millions of pounds, have been made for copper to be delivered in Central Europe after peace arrangements have been signed. It is said that fully a fifth of the total production of the United States is going into storage for delivery at some indefinite time in the future.

The world's output of copper has of late years been only slightly in excess of normal industrial requirements, and the total tonnage produced has shown only a slight increase. The price of the metal was due to rise at or soon after the time when hostilities opened: Now that the war has drawn heavily upon the supply which normally was only barely sufficient, and has removed enormous quantities permanently from industrial channels, there will be big gaps which will be difficult to fill. When it is borne in mind that copper production is not capable of indefinite expansion, it will be seen that cheap copper is not to be expected for a long time to come.

Reports that Germany had discovered cheap substitutes for copper and that this fact would have a future influence on the demand for the metal seem not to be borne out by later developments. Despatches stating that the Central Empires are paying fifty cents a pound for old copper cooking utensils, removing roofs from cathedrals and other fine buildings and melting up bronze statues, seem to indicate that the lack of this metal has not been so entirely covered as has been claimed. It has even been proposed to strip the electric tramways in the rural districts of their copper, which expedient, if followed, would merely pile up a demand to be added to that of the future.

The metal aluminum has been described as an important rival of copper, and its output may be increased almost indefinitely, for the ores of aluminum are abundant. But in the present crisis the lighter metal has not shown the expansion that had been predicted. The extra demand seems to have been met rather less fully by aluminum than by copper. While aluminum sold at eighteen cents when copper stood at fourteen cents, it now brings forty to sixty cents with copper at twenty cents.

Those who have undeveloped copper deposits can safely begin operations, assured of a good market for the metal for some time to come.

The Advance in Silver.

The sudden rise in the price of silver should prove a powerful stimulant to those interested in the resumption of mining in Mexico. The causes which produce a rise or fall in the silver market are commonly understood imperfectly if at all. The present advance is no exception. There are many explanations, but they mostly fail to explain.

One reason given for the new demand is that India and China had for a year or more not taken their usual quota of the metal and that these countries are now in process of catching up. Another is that the nations at war in Europe are using silver money for buying supplies from the peoples around the Eastern end of the Mediterranean. A more interesting reason given is that the soldiers in the trenches carry more small silver money than in time of peace and have more occasion to lose it in the mud. To make up for this loss it is necessary to coin more and to buy more from the miners who have it for sale.

Whatever may be the cause the result is extremely welcome, and should be another incentive to the powers that be to hasten arrengements so that mining will be possible everywhere in this country.

The Mining Geologist Scores Again.

Geologists and chemical engineers are still too often regarded as in the nature of luxuries and unnecessary appendages about a mining camp. It is rarely that one of these "theoretical fellows" gets a chance to score as did a geologist lately in the new gold camp of Oatman, Arizona.

The story goes that the richest mine in the district was discovered by the direct application of geological deduction. Somebody working in one of the earlier mines noticed that a series of ore shoots came to an end in one direction, and he figured out that the enrichment might follow what appeared to be a branch vein in another direction. With a pocket instrument he took the necessary bearings to continue his investigations on the surface. The ground which he considered most desirable had already been staked, but he had enough faith in his "theory" to bond the claim. With the aid of partners a shaft was sunk and the best vein, so far discovered in the district, uncovered.

Are Mining Engineers too Cautious?

Complaints have been appearing in the mining journals about the extreme conservatism of mining engineers when reporting on properties with a view to purchase by their employers. The complaints come, naturally, from those who have mines for sale or prospects which they would like to have accepted as mines. The basis for these charges against the engineers is, of course, obvious, but there is an element of justice which it may be well to take into consideration.

One of the objections to examining engineers is that they earn their salaries not by making money for their employers but by saving it, in protecting their chiefs from risky investment. Their training in the home office, it is said, has a tendency to lay too great stress on the risks involved in mining, and to obscure the great profits which may be the reward for surmounting those risks. When a man has spent years hunting risks, he may in time come to be blind to anything but risks.

That there is some truth in all this is shown by the normal history of almost every exploration company. These organizations of money and brains almost invariably begin operations by classifying and examining a large number of undeveloped mines and prospects. As

time goes on it becomes more and more difficult to interest them in anything but a well-established producer, and they finally end up by acquiring and operating a very few large properties, when they cease to be exploration companies.

Contact with thousands of little excavations which turn out to be valueless must in the end lead to a deep-rooted pessimism regarding all unproved mining property. The member of one of the big exploration companies, who remarked that he, "certainly did not see where the good mines of the future were coming from," had, no doubt been influenced by his training. One can not gaze too long on a single side of the shield without forgetting that there is also another side to that same shield.

The remedy for this one-sided development in men who ought to be entirely impartial would be to have their attention evenly divided between the two sides of the shield. That is, the engineer sent out to "turn down" properties, should also occasionly be compelled to hunt up prospects and try to sell them.

The Newest Thing in Cyanide Mills.

What is announced as the "newest thing in cyanide mills" is a development of the last few months. The concentrating department of the cyanide plant has always been the most unsatisfactory part of the establishment, and lately when fine grinding has been adopted almost universally, it has become even more unsatisfactory. The difficulty of separating minerals from gangue material by the usual gravity methods increases with the fineness of grinding. This has led to the elaboration of stage grinding, the multiplication of machines and equipment and a general complication of detail.

The discovery that flotation works best on fine material and that the process may be applied to alkaline solutions as well as acid mixtures, has stimulated investigations as to whether this process could be applied to cyanide mills. The results have been encouraging and promise to exert an important influence on future mill design. As a preliminary treatment for cyaniding ores, flotation offers many advantages. It is applicable to practically all sulphide minerals, so that it need not be limited to special ores, as is the case with the Nipissing process. It removes not only those minerals which are refractory to ordinary cyaniding but in many cases also those which cause a high consumption of chemicals. It would eliminate the necessity of stage grinding and gravity concentration. The process is simple and inexpensive, and in most cases recovers a high percentage of mineral, even when present in small quantities.

The effect upon the future cyanide mill is still merely conjecture, but certain tendencies are plainly indicated. The elimination of stage grinding will simplify the grinding and crushing department and require less floor space, incidentally giving another push to the departing stamp battery. The very simple flotation equipment will do away with a multitude of launders, shafting, elevators, etc., and cause a further reduction in the size of the mill for the same tonnage capacity. The tailings from the flotation machines will contain a smaller volume of solution than is required in table concentration and will reduce the total volume that must be removed and returned to the battery tanks. This will further reduce the size and the cost of the mill. Finally the pulp which enters the cyanide department may be in better condition for treatment, and the more refractory minerals having been removed, it may require less agitation and a shorter treatment, again simplifying and reducing the size of the mill.

Another effect which is as yet only vaguely indicated concerns a more thorough control of aeration of pulps. The ordinary stage grinding and concentration on tables exposes the pulp to a maximum contact with the air, with its consequent oxidation of iron minerals, production of acid compounds and subsequent destruction of alkalinity and cyanide. The importance of this change in composition caused by super-aeration is as yet only imperfectly understood. With the proper selection and installation of flotation units the aeration of pulp could be largely controlled, and then the effect of excessive, as compared with controlled aeration in the mill, could be noted.

Treating Concentrates at the Plant.

Owing to the lack of transportion and the consequent difficulty of shipping concentrates, a number of mills in this country have been experimenting with processes for the reduction of concentrates to bullion form at the plant. From the meager accounts available it seems that no great sucess has met these efforts, but it is to be hoped that the results will be shortly given to the public. There has been too much secrecy about metallurgical investigations in this country. A hundred heads are better than one, even though the one may be far and away superior to the rest, just as the average of many results of investigations is more reliable than those of a single experiment. Even though conditions which made it desirable to treat concentrates at the plant may never return, it is to the interest of all that the results of these experiments be published.

In general it may be said that the treatment of concentrates on the spot is usually metallurgy on a small scale, and entails all the disadvantages natural to limited operations: high cost, low extraction and the like. The smelters are equipped to handle just such material and the operations, often delicate and difficult on a small scale, are in a large works usually merely incidental to routine work. It is, therefor, not likely that the local treatment of concentrates will ever be profitable where the cost of transportation is reasonably low. There will, however, always be mills where transportation charges are so high that a local treatment would pay even though costs are somewhat high.

LETTERS THE JOURNAL RECEIVES.

To the Editor:

Oro Grande, N. M.

Since leaving South America I have been travelling a great deal and consequently have been unable to send you any permenant address since I sent you my last from Cananea, Sonora.

I miss the Journal greatly and will appreciate beyond words if you will again send it to me to the above address.

I sincerely hope that this will find both you and the Journal the best ever, as always, and with my very best wishes, I am,

Yours very truly.

T. N. Stanton.

Colonel Tepetate.

"Aha! You'll have to change your disposition now," remarked the Colonel briskly as he met the Pessimist proceeding solemnly down the walk. "It must be a big jolt, after having nursed a grouch for years, to have to see things in a brighter light."

"Huh! I don't see anything to be so all-fired cheerful about. What do you find to make you hilarious? I don't see it."

"Of course, of course," said the old man soothingly. "I can imagine how you feel."

"Look here, "retorted the Pessimist. "If you can show me anything that ought to cheer up anybody who isn't quite as loco on the subject as you are, trot it out."

"How would the high price of metals do, and especially the rising silver market? I see some people predict that she'll bust a record and go to 65 cents. From 47 cents to 65 cents is some jump."

"Huh! It's time. Besides, what's the use of high prices when you can't ship?"

"Train service is improving every day. You can now start on a train in several directions, and if you take any kind of precautions, you can be assured of a fairly comfortable trip."

"I am not traveling for my health. I want freight service."

"A little more patience, "advised the old man. "What can you expect after five years of burning and destruction? It takes time, my dear man, it takes time. And already some of the mines are getting supplies. It may be a hard and slow job, but they are getting supplies."

The Pessimist shook his head. "It can't be done that way," he said.

"I don't know what way you mean, but if it isn't that way it will be some other way. Without rail service everybody will be helpless, no work, no industry, no mining and no taxes. When the railroads came to this country there was no demand for them. Now the demand is imperative, and the result is inevitable. Confidence is a relative term, and the abundance and lack of it is expressed in percentages on the stock market. The laws of supply and demand are natural laws, not subject to anybody's whim or decree. The demand will bring the supply as sure as the sun shines in Mexico. Mistakes are inevitable, but the way will be found."

"Even if we do have regular trains, what good will that do if the taxes eat us up?"

"That too will be adjusted according to natural law. I may or may not admit that the present imposts are impossible. But we can be certain of this:— If the takes are so heavy that it is impossible to mine at a profit, there will be no mining. Since mining is the one great industry of this country, you may be sure that there will be mining. To secure that end, the necessary adjustments will be made."

"It will be a long time before it will be safe for foreigners to venture into the outlying districts"

"Some outlying districts have never been as safe as a parlor game of checkers, but I have never seen mining men scared off for that reason. My experience is that you can get mining men to go anywhere at any time. If there are mines and profits, you can't keep them away. The rush to the Klondike began in the winter, and I remember a firm advertising for men to go to the fever swamps of South America and they got ten times as many answers as they wanted. Do you suppose for a minute that the hordes of homesick Gringos sitting along the border and longing for another taste of real frijoles, left this country of their own free will and accord? They were actually chased out, every nother's son of them, by the big noise in the home office. There is a district in this country where killing seems to be a recognized sport, and the record at one camp was thirteen in eleven weeks. During the past two years at least eight Gringos have been murdered there about, not killed in battle or by bandits, but just plain, ordinary, personal killing. Yet foreign help is so easy to get there that one of the mines has never paid traveling expenses. Mining men always have and always will go anywhere and through anything. That's why they make the best soldiers in the world."

"I suppose there are a lot of fellows who are anxious to try their latest stunts in metallurgy here, "said the Pessimist, as much to check the old man's flow of talk as to suggest a new grievance.

The Colonel took the bait like a hungry bass. "And there are some new metallurgical stunts that will more than pay your taxes," he said, "that is, if you've got sense enough not to sneer at them, which I doubt. When just about the biggest concern of its kind in the States builds a several-million-dollar plant on a plumb new idea, and then scraps it within a year for another plumb new idea, I think the rest of us might do something more than smile in a superior way and pretend to know better."

"I suppose you mean me and your everlasting flotation."

"I used to have a Dutch professor who in a case like this always said: 'Who fits the shoe, poot 'im on.' I am going to take a day off some time to tell you what flotation is going to do for mining in Mexico."

"Thanks! I shan't have time."

"To show you how much they think of flotation in the States, here is as pretty a story as ever came out of a book. It seems that in digging into the records of flotation they came across an old patent issued to someone by name, Everson. The patent was outlawed and nobody knew who Everson was, but the patent covered just about all there is to flotation of the latest and simplest type. Finally somebody discovered that Everson was or had been, many years ago, Carrie Everson, a schoolmarm who had been fond of fussing around her brother's assay office, but she and her assayer brother had both disappeared. Lately they have found a son of Mrs. Everson in California, who announces that the inventor of flotation died in comparative poverty a year ago last month. Now they are going to build a monument to her memory."

"Its dead easy to please some people, "observed the Pessimist.

The Concentrator of the Braden Copper Company.*

The crushing plant and concentrator of the Braden Copper Co. are located about two kilometers west of the mines on the northern side of the Teniente river. The topography of the mill site is such that full advantage is taken of a gravity flow of the ore, whether it is in its dry state as it comes from the mine, or after the addition of water as it is handled in the mill. The difference in elevation between the top of the coarse ore bins, where the ore is received from the mine, and the bottom of the filter press plant is 403 feet. The area covered by the entire concentrating plant itself is 130,000 square feet.

The Crushing Plant.

The ore is transported from the mine to the coarse ore bins by means of an electric railroad, and is weighed before it is dumped. These bins have a storage capacity of 2,300 tons. Mechanical feeders deliver the ore to a belt conveyor system, which carries it to the crushing plant.

The crushing plant is divided into two sections which have the same number of machines and the same rated capacities, only one of which will be described. Each of these sections takes half of the stream from the last conveyor of the system. The ore passes over a 1½ in. grizzly, or series of flat steel bars placed edgewise at an angle of about 45°. The oversize, or coarser material, falls directly into a gyratory crusher; while the undersize, or "fines," joins the crusher discharge which has been crushed to an average diameter of less than two inches. These two products are then crushed in a pair of rolls 6 ft. diameter and 20 in. wide, to such a size that none of the pieces are larger than 7/8 in. in diameter.

The discharge of the 72×20 in. rolls is divided into two parts, each passing into a cylindrical revolving screen or trommel. This has diagonal openings, 6 mm. ×30 mm. through which the smaller pieces of ore fall. This portion is carried direct to the fine ore bins by means of conveyor belts. The portion which cannot pass through the trommel flows into a 48 in. Symons disc crusher, which crushes the ore to a maximum size of 5/8 in. between two manganese steel discs rotating in the same direction and the same speed, but supported at an angle to each other.

The discharge of the Symons crushers passes over shaking (impact) screens with openings 6 mm. ×30 mm. The smaller pieces are shaken through and are taken to the fine ore bins by means of the same conveyors mentioned above. The large pieces, which cannot pass through the screen, run to two 36×15 in. crushing rolls, where they are further reduced in size.

The discharge of these roll is elevated by means of a bucket elevator, and is passed over another set of impact screens, where more fine material is taken out and conveyed to the fine ore bins. The oversize, is divided, approximately one third running to the two 36 ×15 in. rolls mentioned above, and the remainder to two more 36 15 in. crushing rolls, for further grinding. The discharge of these rolls joins the discharge of the first set of 36 in. roll and is elevated and passed over the same screens again. By means of this arrangement all the ore must pass through the 6 mm. ×30 mm. openings of the screen, before it reaches the fine ore bins preparatory to further treatment.

* Abstract of a description by "The Mill Staff" in Teniente Topics.

The Concentrator.

The fine ore bins have a storage capacity of 3,000 tons. From here the ore is delivered to the concentrator building by means of belt conveyors. The mill is divided into three sections, each with a nominal capacity of 1,200 tons per 24 hours, only one of which will be described, as the other two are similar.

From the final belt conveyor the ore passes over four impact screens with 25 openings to the square inch, making a separation between the smaller particles, which can now receive their first concentration, and the larger ones which require further grinding in order to liberate the free mineral. These large particles run from the screens down to two sets of rolls, then to an elevator, the discharge of which joins the fine particles which have passed the screens. At this point water is added and the ore flows to four trommels with screens having the same sized opening as the impacts. The material which passes through these screens, is fed to six Wilfley tables, on which, by means of a quick shaking motion and a stream of water, a separation is made of the heavy particles of copper sulphide and the lighter particles of sand.

The recovered mineral, or concentrate, flows down to collecting tanks, at the foot of the mill; while the sand, which still contains a large amount of adhering mineral, needing further grinding to free it, is conducted to eight Hardinge mills.

The Hardinge conical mills are half-filled with pebbles, which have a maximum diameter of five inches. The mills revolve at 28 revolutions per minute, with the result that the coarse sand fed into them, comes out very finely ground. The oversize of the trommels mentioned above is also treated in these mills.

All the discharge is now run to two drag classifiers, where by means of chains to which blades of sheet iron are attached, the coarse sand is separated from the very fine slime. The sand is concentrated on six tables similar to the ones at the head of the mill, the concentrate going to the collecting tanks, and the reject sand to the next floor of Hardinge mills for still further grinding.

On this floor there are six mills, which reduce the above reject or table tailing to the size required for the final process of concentration. These mills are each fed by a drag classifier, the slime overflow of which runs direct to the flotation plants. The whole discharge of the mills is elevated and returned to the classifiers, so that no large particles can escape from the circuit.

Flotation Plant.

The ore has now been ground so that approximately all but ten per cent will go through a 60 mesh screen. The final concentration is effected by means of the Minerals Separation Ltd. process. This is carried out in eight standard M. S. plants which treat the tonnage handled by the three mill sections. Briefly, this process consists in adding a small quantity of suitable oil and sulphuric acid to the finely ground ore, thoroughly mixing them, and then allowing the resulting froth to come to the surface. This froth floats up with it the particles of copper sulphide, leaving behind the particles of gangue material. The operation is carried out in wooden compartments, in each of which is an agitator revolving rapidly, and connected to another com-

partment in front, in which the mixture comes to rest and the float is collected. The material travels from the agitating compartment to the settler, from the settler to the second agitator, and so on until almost all the values have been extracted.

The float from the last two boxes of each plant is very low in copper value, and is collected separately and re-treated, this pulp being pumped back to join the original feed of the plants.

The sand, from which most of the values have now been extracted, is all collected into one launder, passed through a sampler, and then conducted, down the valley to the tailings dam, where it is stored.

The concentrate is collected in concrete tanks at the foot of the mill, from which it is loaded by means of a crane into railroad cars, to be taken to the smelter.

Filter Press.

The overflow of these tanks, consisting of sulphide slime too wet to be smelted, is run to Dorr thickeners, which are large settling tanks, in which slowly-revolving arms, (to which small ploughs are attached). convey the settled concentrate towards a central discharge in the tank bottom, the clear overflow being sent to waste.

The thickened concentrate is then filter-pressed in two types of machines: the Kelly press and the Oliver filter. The Kelly press, by means of compressed air obtained from there compressors in the mill collects the slime on the leaves of a filter, forcing the water through. The Oliver is a revolving drum covered with canvas through which a vacuum pump draws the water, leaving the comparatively dry slime to be scraped off automatically. The product of both machines is loaded directly into railroad cars for the smelter.

General.

The following tabulation gives the essential operating data:

Tons per man per day	8.5
Kilowatt hours per ton milled	29.6
Acid per ton milled, lbs	7.00
Tar Oil per ton milled lbs	2.00
Fuel Oil per ton milled, lbs	0.30
Local pebbles per ton milled, lbs	8.75

On account of the location of the plant in a foreign country, and consequently the long distance from the main base of supplies, the duties and ocean freight on all sorts of material bring the item of supplies up to 60.4 per cent. of the total direct milling cost. The percentage of total costs assessable to the various departments, for labor and supplies respectively, is shown in the following tabulation. This also shows the proportion of the total direct milling costs which are borne by the different departments.

	Labor	Supplies
Coarse ore bins and Conveyors	4.07%	2.51%
Crushing plant	21.29	16.02
Fine ore Bins, Conveyors, Mill Rolls and Screens	9.02	7.17
Table Concentration	7.04	2.97
Hardinge Mills	21.98	25.00
Oil Flotation, Main Plant and Retreatment	22.81	42.58
Concentrate Handling	8.33	1.14
Filter Presses	5.46	2.61
	100.00%	100.00%

This article in an attempt to make the milling procedure clear to the layman, undoubtedly fails to cover much that would interest the mill man. However, it is hoped that future articles by members of the Mill staff will atone for the lack of technical information in this contribution.

*Electrolytic Precipitation of Gold, Silver and Copper from Cyanide Solutions.**

By G. H. Clevenger.

The present unsettled condition of the metal market, more particularly as regards zinc, which is used now almost exclusively as a precipitant in the cyanide process, makes a consideration of electrolytic precipitation, which is apparently the most feasible substitute, of particular interest at this time.

The electrolytic precipitation of gold, silver and copper from cyanide solutions in connection with the cyanide process of gold and silver extraction, has frequently been the subject of satisfactory laboratory experiment, but much less frequently of successful commercial application. This comes about through the fact that experiments carried on for a few hours in the laboratory give no true indication of the life of anodes, formation of by-products, etc., to be expected in continuous operation.

My purpose in presenting the present paper is not to give a theoretical discussion of the subject or to make new proposals for improved types of electrolytic precipitation apparatus, but rather to describe the few commercially successful installations which have been made, calling particular attention to the difficulties which have arisen in their operation, in the hope that it may prove useful to those who have to do with the installation of electrolytic precipitation equipment.

In order that those of our members who are not familiar with the cyanide process may properly appreciate the peculiar and difficult problem which the complete precipitation of gold and silver from dilute cyanide solutions present, I will digress sufficiently to make this clear before taking up the description of the various attempts to solve the problem. The solutions which are precipitated in present-day cyanide practice may contain a great variety of compounds arising from the decomposition of the cyanide, as well as from its combination with elements occurring in the ore treated, or introduced by chemical methods of precipitation. The principal constituents of such solutions, if zinc precipitation were not used, would be: Simple alkaline cyanides, alkaline hydrate, gold and silver, and copper if it occurs in a soluble form in the the ore undergoing treatment. The proportion of these various constituents present, particularly of the gold and silver, is extremely small compared with the amounts of metal present in solutions made by extraction processes in other industries.

Kind of Solutions Treated.

In general the simple alkaline cyanide, as indicated by the Liebig titration test, will range in present-day practice from a trace to 0.25 per cent, or a maximum of 1/400 of the solution. In certain cases of sand treatment of silver ores stronger solutions are used, but in general the cyanide strength of the solutions precipitated will fall well below the upper limit given. The

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alkali generally added is lime, although caustic soda has been used. These is rarely over 100 points present and most generally much less than this, and in some cases practically no protective alkalinity. (One hundred points of alkali correspond to a saturated solution of lime in distilled water at 20 deg. C., i.e., 0.13 per cent.) The proportion of alkali present is therefore in many cases less than the cyanide.

The gold present will range from nothing to 0.5 ounce (15 grams) per ton, and the silver from a trace to 10.0 ounces (292 grams) per ton. In general the proportion of gold and silver in solution is much less than the upper limits given.

The grade of the ore treated does not always form a safe criterion of the gold and silver content of the solution, for the reason that the ratio of the weight of solution used to the weight of ore treated, or, as it is generally termed, "the dilution," varies greatly, but in general, as might be expected, is greater with high-grade ores. Thus, if three tons of solution are used in treating one ton of ore, we have a 3 to 1 dilution, and the recoverable value of the ore has been transferred to three parts of solution, the average value of which would be one-third of the recoverable value of the ore treated; or, to take the concrete case of an ore assaying 0.50 oz. (15 g.) of gold per ton (approximately $10 per ton) from which 90 per cent of the gold can be extracted by cyanide solution, there would be dissolved by the solution 0.45 oz. (13. 2g.) ($9) per ton of ore treated. With a 1 to 1 dilution the average content of the solution per ton would be 0.45 oz. (13.2 g.) ($9); with a 3 to 1 dilution the average content of the solution per ton would be 0.15 oz. (4.4 g.) ($3); with a 5 to 1 dilution the average content of the solution per ton would be 0.09 oz. (2.6 g.) ($1.80).

It will, therefore, be apparent that this stage of the cyanide process, the transference of the gold and silver from the solid state as occurring in the ore, to the liquid state as dissolved in the cyanide solution, is unlike most other steps in metallurgy, which are in general to successively concentrate the metal sought into a smaller weight of material. Exceedingly small as is the proportion of gold and silver present in ores which it is possible in present-day practice to profitably treat by cyanidation, the proportion of gold and silver in the solutions requiring precipitation are generally still smaller.

Small Amount of Metal Involved.

Perhaps a clearer idea of the small amount of metal involved, particularly in the case of gold, will be obtained by expressing the proportion fractionally. In solutions containing 0.50 oz. (14.6 g.) of gold per ton (approximately $10), an unusually high proportion, the gold would form only 14.6/1,000,000 or 1/58,332 part of the solution. In the case of waste solutions, which are or should be precipitated before they are discarded, it is not unusual to deal with solutions containing less than 0.01 oz. (0.29 g.) of gold per ton (20 cents), or only 1/22,916,600 of the total weight of the solution. Tail solutions containing only 1 or 2 cents values per ton are regular practice at many mills using zinc dust precipitation.

At the present market price of silver (about 50 cents per ounce) there would be required about forty times the weight of gold present to give an equivalent value in silver. Therefore, in the treatment of silver ores a much greater weight of metal would be involved, but still the relative proportion of metal to the total weight of solution is small. As gold and silver most frequently occur associated, the absolute weight of metal to be precipitated will depend upon the ratio of these two metals in the ore treated. The greater weight of metal involved in the treatment of silver ores or ores in which silver predominates, perhaps in a certain measure explains the greater ease with which solutions resulting from the treatment of such ores are handled by all precipitation processes.

Copper in solution is an incident of gold and silver extraction, as at present there is no effort made to recover copper in this way; however, this is an interesting possibility, and would be feasible provided the cyanide combined with the copper could be economically regenerated. In many cases the proportion of copper in solution will be less than that of the gold and silver, and, so far, even with electrolytic precipitation, there has been no serious attempt to treat gold and silver ores by the cyanide process unless the proportion of readily soluble copper was considerably below 1.0 per cent. The interference of copper with other methods of precipitation, as well as its prejudicial effect upon extraction, make a consideration of its behavior with electrolytic precipitation of particular interest, but beyond the province of the present paper.

The electrolytic precipitation of gold and silver from cyanide solutions, therefore, involves the practically total precipitation of an extremely small weight of metal from solutions containing a comparatively small proportion of soluble salts, and which are therefore poor electrical conductors. The fact that the alkaline cyanides are readily decomposed by electrolysis and that the economy of the cyanide process depends upon the continued re-use of the solvent make it imperative to precipitate with the minimum decomposition of cyanide, and preferably with a regeneration of cyanide. The difficulty of the problem at best will therefore be apparent.

Siemens-Halske Process, on the Rand, South Africa.

The precipitation of gold and silver from cyanide solutions by electrolysis, employing a soluble anode of the metal to be deposited, had been practiced in electroplating long before the complete precipitation of gold and silver from the dilute solutions resulting from ore treatment was attempted by electrolysis, using an insoluble anode.

In 1887 a British patent was granted on the MacArthur-Forrest process of gold and silver extraction, involving the use of dilute solutions of potassium cyanide and zinc precipitation. In the same year, Dr. Siemens, working independently and acting upon observations made at his plating plant at Berlin, Germany, taken together with the statements of chemical authorities that gold was soluble in solutions of the alkaline cyanides, developed a process of gold and silver extraction involving the use of dilute solutions, more dilute than those at first used with the MacArthur-Forrest process, and electrolytic precipitation.

In the course of this work zinc filings had been tried as a precipitant, but with the very dilute solutions employed electrolytic precipitation proved more satisfactory. The first experimental plant was erected at Siebenburgen for extracting gold from concentrates, and although the process was in successful operation as early as 1888 in other mining localities it was not until a number of years later, in 1893, that the Siemens-Halske process was introduced into the Rand gold field of South Africa.

On the Rand, at first, only the sand portion of the ore pulp resulting from the stamp-crushing and plate-amalgamation process could be successfully treated by cyanidation, as leaching was the only method of treatment then in use. The solutions resulting from sand treatment contained sufficient free cyanide to give satisfactory results by ordinary zinc-shaving precipita-

tion, as then practiced. This method of precipitation was, therefore, almost universally used for these solutions.

With the advent of the decantation method of treatment for the unleachable portion of the pulp, which had previously been allowed to accumulate on account of not being amenable to treatment by leaching, the problem at once arose of precipitating from large volumes of solution which were weak in both cyanide and gold on account of the high dilution necessary in treating slime by the decantation method.

At this time the ordinary zinc-shaving method of precipitation did not give satisfactory results when used with very weak solutions. The Siemens-Halske electrolytic process of precipitation, therefore, came into very general use for precipitating the solutions resulting from slime treatment.

The Siemens-Halske process was first introduced at the Worcester mine. Installations at other mines rapidly followed until at one time there were about twenty in operation on the Rand. In the Siemens-Halske process, iron anodes ⅛ to ¼ in (0.3 to 0.6 cm.) thick, and lead-foil cathodes about 0.00032 in. (0.008 cm.) thick were used. In general, the anodes and cathodes were set vertically and about 1½ in. (4 cm.) apart. There was considerable variation in the size and arrangement of the anodes and cathodes. At the Worcester plant they were 7 ft. long by 3 ft. wide (2.1 ×0.9 m.), but in later installations, to facilitate handling, they were made smaller. The anodes were enclosed in sacks of textile material for the twofold purpose of preventing short circuits and of collecting the prussian blue and iron oxide formed from the iron anodes.

The lead-foil cathodes were frequently cut in narrow strips for the purpose of increasing the surface. These were strung upon iron wires mounted in light wooden frames. Another expedient which gave still greater surface was to cut the lead into shavings similar to zinc shavings. These were packed into the space between the covered anodes.

Various arrangements of the precipitation units were tried, but the one which seemed to be the most favored was to construct the containing box with alternate wide and narrow compartments, the narrow compartments serving for the downflow of the solution, while the anodes and cathodes were suspended in the wide compartments, through which the solution had an upward flow. This general arrangement will be recognized as being similar to that of the boxes used for zinc-shaving precipitation.

The current density used was from 0.03 to 0.06 amp. per square foot (0.33-0.66 amp, per sq. m.) of anode surface. The aim was to obtain a coherent plating of the gold upon the lead cathodes. After sufficient gold had accumulated upon the cathodes (2 to 12 per cent of their weight) they were removed, melted and the gold recovered by cupellation, either locally or at a central reduction plant.

There was a long and bitter controversy on the Rand regarding the relative merits of zinc and electrolytic precipitation. In 1898, Betty, by means of a drip of strong cyanide solution at the head of the zinc boxes, in conjunction with the zinc-lead couple, which was first proposed by MacArthur in 1894, demonstrated that zinc precipitation could be satisfactorily used for solutions low in both cyanide and gold. After satisfactory precipitation of these dilute solutions by zinc became possible, electrolytic precipitation rapidly lost ground and finally was entirely superseded by zinc precipitation.

Practice at Minas Prietas, Mexico.

E. Andreoli, early in 1895, while working with the Siemens-Halske process in South Africa, accidentally discovered the lead peroxide anode, and although the advantages of peroxidized lead over iron as an anode material were at once recognized, it does not appear to have been used to any exent in that locality, possibly for the reason that electrolytic precipitation, at the time that this development was announced, was being rapidly displaced by zinc precipitation. After investigating many possible cathode materials, Andreoli suggested iron as being the best on account of its cheapness, strength, and the firm adherence of the gold to it. Borchers, however, states that from the electrochemical stand-point the use of iron cathodes is theoretically incorrect. Andreoli proposed recovering the gold from the iron cathodes by dipping them in a bath of molten lead. The gold was to be recovered from the lead by cupellation. The iron cathode used in this way does not appear to present any advantage over the lead-foil cathode, as it also involved the use of lead and necessitated the operation of cupellation.

In 1899, Charles Butters, who had been prominently identified with the introduction of the Siemens-Halske process in South Africa, assisted by two members of his former staff, H. T. Durant and E. M. Hamilton, developed a new electrolytic precipitation process which was first sucessfully used for a number of years in connection with the cyanidation of a large deposit of pan-amalgamation tailings, and later of ore directly, from the mine at Minas Prietas, Mexico.

The original installation for electrolytic precipitation consisted of six wooden boxes, 30 ft. (9 m.) long by 10 ft. (3 m.) wide and 5 ft. (1.5 m.) deep, having a slope of 1 in. to the foot (8 cm. to 1 m.) toward one side, to facilitate the removal of precipitate. The boxes were divided by wooden partions into alternate wide and narrow compartments, twelve of each. The partitions were so arranged as regards the bottom that the narrow compartments throughout the box served only for the downflow of the solution, whilst the wide compartments, in which were ,suspended the anodes and cathodes served for the upward flow of solution.

This general arrangement of the compartments is the same as that used with the Siemens-Halske process. Each wide compartment was fitted with eighteen lead anodes whose surface was coated with lead peroxide, formed by electrolysis in a special cell, and seventeen cathodes composed of lead foil, cut in strips, strung upon wires supported by wooden frames similar to the cathodes used with the Siemens-Halske process in South Africa.

The current was supplied by two Siemens-Halske dynamos, each capable of developing 250 amp. at 30 volts, feeding into copper bus bars 1¼×¼ in. (3.1× 0.6 cm.) laid on top of the boxes.

In order to insure good contacts, the wires leading from the individual anodes and cathodes were soldered to the bus bars, mercury-cup contacts having proved unsatisfactory.

The solution passed through three sets of boxes, each set comprising two boxes set in tandem. One set of two boxes was used for precipitating the solution resulting from sand treatment and two sets of four boxes for precipitating the solution resulting from slime treatmen.

The current density was so regulated that the metals were deposited as a flocculent precipitate which largely fell to the bottom of the compartments in the form of a fine slime, as in zinc-shaving precipitation, rather than as an adherent coating upon the cathodes as in the Siemens-Halske process.

After a short period of operation, it was found that the precipitate did not all fall to the bottom of the box, but that part of it formed as a rather loosely-adherent mass on the cathodes. This necessitated washing and shaking of the cathodes when it was desired to make

a complete clean-up. It was soon apparent that the fragile lead-foil cathodes could not long withstand such treatment so an investigation was started with the view of finding a more satisfactory cathode. This resulted in abandoning the lead-foil cathodes in favor of a cathode made from ordinary tin-plate, which possessed the necessary strength and from which the precipitate could be readily brushed without removal of the cathodes from the containing box.

The pan-amalgamation tailing cyanide at this plant resulted from the treatment by raw pan-amalgamation of a comparatively simple siliceous silver-gold ore. The tailing contained copper, mercury and chlorides as a result of the chemicals added during amalgamation. After the tailing deposit had been exhausted, the low-grade ore which had been left in the mine was treated. The pulp was separated into sand and slime, the sand being treated by percolation and the slime by agitation, natural sttlement and decantation. The volume of the solution precipitated varied as did also its metal content. The percentage of cyanide and alkali were less variable, but by no means constant.

Below are given average figures covering two months' operation, for solutions resulting from sand treatment when pan-amalgamation tailing was being treated. Average amount of solution precipitated per 24 hr., 216 tons. Current density 0.55 amp. per square foot (60 per sq. m.) of anode surface. The voltage across the anodes and cathodes varied in the different compartments, but average about 3. The head solution, or solution entering the precipitation boxes, contained: 0.147 oz. (4.14 g.) gold per ton; 3.51 oz. (102.4 g.) silver per ton, and 0.0792 per cent of cyanide in terms of potassium cyanide. The tail solution or solution leaving the electrolytic precipitation boxes contained 0.013 oz. (0.379 g.) gold per ton; 0.29 oz. (8.46 g.) silver per ton, and 0.0938 per cent cyanide. The gain in cyanide was 0.0146 per cent. As there was used 1.2 tons of solution in treating each ton of sand, the cyanide apparently regenerated amounted to 0.35 lb. (0.16 kg.) per ton of sand. The percentage of gold precipitated was 91.0 and the percentage of silver precipitated was 91.7. No attempt was made to lower the gold and silver in the tail solution, as none of it was used for final washes.

The following are average figures covering the same two-month period for the precipitation of solution resulting from slime treatment: Average amount of solution precipitated per 24 hr., 480 tons. Current density 0.3 amp. per square foot (3.3 per sq. m.) of anode surface. The voltage across the anodes and cathodes averaged 2.6. The head solution contained: 0.133 oz. (3.88 g.) gold per ton; 1.45 oz. (42.3 g.) silver per ton, and 0.0409 per cent cyanide. The tail solution contained: 0.055 oz. (0.160 g.) gold per ton; 0.15 oz. (4.37 g.) silver per ton, and 0.0527 per cent cyanide. The gain in cyanide was 0.0118 per cent. As there was used four tons of solution in treating each ton of slime, the cyanide apparently regenerated amounted to 0.94 lb. (0.43 kg.) per ton of slime. The percentage of gold precipitated was 88 and the percentage of silver 89.6. When the solution flow was cut down to two-thirds normal, the tails contained 0.0025 oz. (0.073 g.) gold and 0.06 oz. (1.75 g.) silver per ton. The regeneration of cyanide was doubtless greater with the solution resulting from the treatment of the slime on account of the greater percentage of copper which it contained. When treating ore directly from the mine, which contained little or no copper, the regeneration was not sufficient to be detected by ordinary titrations.

Zinc Oxide from Lead Blast Furnace Slag.[*]

When the "National" plant of the American Smelting & Refining Co., located at South Chicago, Ill., was dismantled early in 1915 some of the buildings were spared and the place was leased to Messrs. Hedges and Divine for the recovery of zinc oxide from the slag dumps.

B. F. Hedges had been superintendent of the refinery for over seven years and R. D. Divine had been metallurgist at the same place for some years. These men had previously made several laboratory tests and short experiments even, with the large blast furnace to study the expulsion of the zinc from slag on heating with limestone and coke. They had the courage and confidence to make alteration, install the additional equipment necessary and start operation at their own expense. Cheerful to relate, the experiment is successful; their hopes are largely fulfilled, and each day's operation adds to their profits.

The process consists of smelting the refinery slags in the lead blast furnace with additional lime and considerable coke on the charge; the furnace is run with hot top and the heavy zinc fume is collected in bags as the finished product of the operation.

The principle of the process is not essentially different from similar work as carried out at the Oker plant in the Harz mountains or in California plants, which have smelted copper ores high in zinc with volatilization of more or less of the zinc. The condition of best operation as at present worked out is worth attention, while the successful prosecution of the experiment will doubtless be copied with renewed vigor wherever circumstances shall allow.

[*]Abstract of an anticle by H. B. Pulsiver in Metallurgical and Chemical Engineering.

The Slag Dump.

The slag dump as left by the lead refining operations covering a quarter century covers a space of some 4 acres and contains a maximum of possibly 150,000 tons of slag running over 10 per cent metallic zinc. Certain spots in the dump will probably contain as high as 15 per cent zinc; it will mostly average 12 per cent, but some piles of coal ashes will have to be moved to get at the slag under them. The slag is, of course, practically all that runs from the lead blast furnaces previously charged with the refinery residues. The zinc came from the skimmings off the refining furnaces after the desilverization by the Parkes process, this skim, along with many other residues and materials, constituting an important part of the blast furnace charges.

Handling the Materials.

This is accomplished by the Browning locomotive crane. The crane digs out the slag and carries it to the hopper above and close to the feed floor of the furnace. The granulated slag is lifted out of the granulating tank by the same crane and deposited in cars or taken back to the dump on the water front, as desired. The limestone, coke, and any other materials can be brought to the furnace by the tracks, bins and elevator formerly used for the same purpose. The

locomotive crane was new equipment supplied by Hedges & Divine.

The Blast Furnace.

The former bullion blast furnace, which had long been used in a shortened condition, was lengthened out from five to nine jackets on a side, making the furnace now about 46 in.×156 in. at the tuyeres. The crucible and curb were built up another foot to get more fall to the granulating tank, while the inside capacity of the crucible was largely filled in, and has since become entirely so, slag and lead now flowing out together into the small pot forehearth. Raising the jackets shortened the curtain of brickwork above them up into the shaft but presented no difficulty. From the settling pot the slag flows out through a trough into the granulating tank.

Considerable experimentation as how best to feed the furnace finally resulted in low hand feeding one side only.

The top of the charge is kept nearly at the level of the feed floor; the top is usually red hot; a dense white fume subdues the flickers of the red (calcium) and green (zinc) flames which play up into the big brick flue head.

The furnace is now running smoothly on 12-oz. blast and taking around 65 tons per twenty-four hours. The charge consists of the dump slag, limestone and coke (partly coke breeze). Recovery of zinc is probably not over 50 per cent, for the granulated slag still goes some 5 per cent zinc. Besides the oxide driven off there is a noteworthy recovery in lead bullion and speiss—a ton or so each day. This bullion and speiss is, of course, silver-bearing. No change was made in the tuyeres for the new work; there are nine on each side, one to each of the cast-iron jackets; they are approximately 3.5 in. inside diameter. No crusts or hangs have yet appeared inside jackets or shaft after more than two months' steady running.

Collecting the Oxide.

The white oxide which is evolved from the charge in billowy puffs is drawn through about 700 ft. of steel flue by a fan at the bag house. This fan is a No. 80 exhauster made by the Clarage Foundry & Machine Co. of Kalamazoo, Mich. An Allis-Chalmers direct-current motor, 25 hp., taking 220 volts and 96 amp. at full load, pulls the fan.

The temperature of the gas is held just under 200 deg. Fahr. A rather heavy fume settles out and builds up in the flue nearer the furnace; this is removed mostly through hoppers, but to get it all out the furnace must be temporarily banked so that men can enter.

The oxide is collected in six Prinz & Rau dust collectors and the bags are filled. This bag room immediately adjoins the fan room. The flue from the fan is divided to supply each each of the six machines; from the machines the collecting flue for the gases leads through another fan to the stack. Unless a bag is damaged and leaks there is no visible exhaust from the bags. The Prinz & Rau machines have many small bags in lines under one supporting base for each line. As each line of bags comes vertical on the cycle the motion halts, the pressure has already died out in that line of bags a sharp knocking dislodges the collected oxide; then the machine starts another notch to bring perpendicular the next line of bags, the cleaned bag is again inflated and passes downward around the axis. The dislodged oxide falls into a trough; a screw conveyor works it forward to the inclined trough, falling sharply into the paper bag. A full bag has averaged 55 lb. weight, the product containing about 74 per cent zinc and 6 per cent lead.

With the present fancy prices for spelter and oxide the recovery of some 3 tons of oxide a day represents a very respectable profit on the venture. Recovery is, however, far from what might be wished, while the cost of fuel is somewhat large. Further work ought certainly to remedy these defects. There is here a splendid example for further efforts on other dumps and at other plants. Not so very much of improvement would make the process workable on many a zincy dump; not much imagination pictures slag running from blast furnaces into converters (such as the Fink furnace) for the recovery of zinc after smelting for lead without intermediate cooling of the slag.

Various Measures of Stone.

Owing to the variety of uses to which stone is put, there is no regular unit of measurement employed by the quarrymen, the stone being sold by the cubic yard, cubic foot, ton, cord, perch, rod, square foot, square yard, square, etc. Building and monumental stone, especially the dressed product, is usually sold by the cubic foot or the the cubic yard, although this unit varies with the class of stone and with the locality; a large quantity of rough stone is sold by the perch, cord, or ton. Rubble and riprap, including stone for such heavy masonry as breakwater and jetty work, are generally sold by the cord or ton. Fluxing stone and stone for chemical use—as for alkali works, sugar factories, carbonic-acid plants, and paper mills—are sold by the long ton. Flagstone and curbstone are sold by the square yard or the square foot, the thickness being variable and dependent on the orders received. Granite paving blocks are sold invariably by number but the blocks are not of uniform size the value depending on the size of the block and the labor necessary to cut into the shape desired. Other paving materials is sold by various units, such as ton or cubic yard. Crushed stone is usually sold by the cubic yard or ton, the short ton being more generally used. The weight of a cubic yard of crushed stone varies from 2,300 to 3,000 pounds, the average weight being about 2,500 pounds. In certain localities crushed stone is sold by the "square" of 100 square feet by 1 foot, or 100 cubic feet. Crushed stone is also sold by the bushel, 21½ bushels representing a cubic yard of about 2,700 pounds.

How Sandstones Differ.

The products of rock decomposition may be reconsolidated either by great pressure or the injection of cementing materials, or by both. Thus sands are formed into sandstones, clays become shales, and calcareous deposits yield limestone. Aside from their cementing materials, sandstones differ in composition exactly as did the sands of which they are composed. Sandstone, according to the U. S. Geological Survey, may be nearly pure quartz, or quartz and feldspar, or quartz, feldspar, and mica and it may vary in texture from the fine to the coarse. Some sandstone is so coarse that it will hold 6 quarts of water to the cubic foot, and underground deposits of such sandstone form excellent reservoirs, which may yield a never-failling supply of water. An arkose sandstone from the quicksilver region of California, made up of granitic detritus, was found to contain quartz, orthoclase, oligoclase, biotite, muscovite, hornblende, titanite, rutile, tourmaline, and apatite. In short, all the rock-forming minerals which can in any way survive the destruction or grinding up of a rock may be found in sands, and therefore in sandstones.

The Closed Circuit in Tube Milling.

W. J. Pentland writing from Guadalajara to Chemical and Metallurgical Engineering re-opens the question of tube mill practice. He says:—

Closed circuit would seem to be with us to stay, at least for quite a while; so were fine feeds and high discharges, but after a while they went their way.

There is no doubt that the economical result obtained should guide, and as shown in the discussion of the article by Mr. Haynes and his table of results, a cumulative load of 570 tons will give a net grinding to minus 200 of 58.59 tons. And the relative time that each ore particle is in the tube-mill may be fourteen minutes, that is, for each round; but does it not circulate six or seven times and in the end be eighty-four to 100 minutes in the tube-mill anyway? Is there any advantage in circulating pulp so much if the same result can be had without so doing? It costs something to return pulp to the tube-mill, even when using drag classifiers. Is there not something radically wrong with any system of crushing when it is necessary to return the pulp so many times in order to reach a desired result?

As there can be no argument over the crushing machine used; i.e., that the tube-mill, with its load of pebbles, furnishes all the elements necessary to successfully break or grind sand of six or finer mesh down to minus 200, we must look into the condition of the feed in order to find some condition that can be changed so that better results may be had.

In the earlier years of tube-mill experience it was generally thought that the feed—the battery discharge—had to be relatively fine in order that the tube-mill might be able to do its work. Thirty-mesh screen on the batteries was quite common. Nowadays most mills use coarse screen, six, eight, ten or twelve-mesh on the batteries. This change in general custom may be considered proof that tube-mills can successfully grind more net tons of coarse feed than they can of fine feed. It is in order then to find the reason why this should be so.

Pebble and Pulp.

May it be that between two pebbles equal volumes of coarse pulp and of fine pulp will be caught, and in each case the total volume be reduced to ultimate size; and that the volume of coarse pulp weighing more than the same volume of fine pulp, there is a greater resulting tonnage ground in the case of the coarse pulp? I believe that this is what takes place, and while total volumes are not really ground at once to ultimate size yet equal proportions of such volumes will be ground, so the same relative result is obtained; more coarse pulp is reduced in the operation than would have been the case had the pulp been fine. This, of course, implies coarse feed, reasonable in size, such as the six-mesh and nearby sizes, when compared with the sizing of the pulp returned from the mill when fed with overload.

I cannot agree with any theory that a six-mesh particle of ore must go through a tube-mill five to seven times, being somewhat reduced on each passage, until it will finally emerge a 200-mesh particle. I think that if it once lodges between two pebbles in action it will at once be ground or broken so that the larger portion of it will be ground to minus 200, and the remainder will be approaching that size and must again be caught between other pebbles in order to be finished to 200-mesh. Poor grinding occurs because ore particles go through the mill without being caught between grinding surfaces and not because the force applied is insufficient to reduce the particles at one operation; there is an excess of force applied, but much of it is not utilized, as only those particles of ore actually between the rubbing surfaces are fully ground, and those particles that lodge just outside the points of contact get only partial grinding.

With pulps of mixed sizes of ore particles, the coarse sand will come into play or be exposed to grinding conditions before the accompanying fine sands. The coarse sand parts with its water more readily and clings better to the pebbles; its comparative diameter also is greater and there is less chance of its passing between the pebbles; a fine particle might escape entirely where a large one would be caught, and being caught it is at once reduced greatly to a finer mesh. In the succeeding part of the mill all ore particles are approximately of the same size, most of the fine feed going through without any grinding, and to that is added the fine stuff left from breaking down the coarse part of the feed, so we go on accumulating return load until the gross load fed to the mill is something out of all reason.

Impact or Attrition?

When we reduce an ore sample in a mortar with a pestle we reach a point in the operation where we can no longer apply force of impact and get any results: we must resort to force of abrasion. When we put the pulverized sample on the bucking board we do not strike the pulp with the muller, we rub it or rather grind it by abrasion. It is universal custom to reduce sands and ore pulps for assay purposes to sixty, eighty or 100-mesh by abrasion, yet in tube-milling many seem to think that to reduce such pulps to 200-mesh force by impact should be applied. And so they contend that the mill revolutions should be such that the pebbles fall clear of the upcoming load. With the body of the mill half full of fluid pulp there cannot be much by impact expended when the falling pebbles reach bottom after passing through the thick pulp floating in the mill. With pulps as dilute as 38 to 40 per cent. moisture most of the fine parts of the ore will be in suspension, due to the violent agitation, and the coarse sands will have settled to the bottom where they are ground by abrasion, not impact.

Grinding pans are in many places considered superior to tube-mills for producing minus 200-mesh pulp; they crush by abrasive force, not by impact. If we wish to obtain abrasive grinding in tube-mills the revolutions must be so adjusted that the pebbles just begin to cascade, but the main body slides back over itself without falling clear.

Battery sand is of relatively small size when compared with the irregularities or projections on the surfaces of tube-mill pebbles. Sand caught between two pebbles struck together is more likely to escape crushing than to receive it; if the same two pebbles were rubbed together the sand would more likely be crushed than to escape, as the inequalities on the two pebble surfaces would more likely fit into one another than to rest on the points while in motion.

As to sufficiency of force applied, I think that the weight of the load of pebbles, coupled with the dragging exerted by the liners causing the pebbles to push one against another, is ample to crush ordinary six-mesh and finer sizes. If crushing of ¼-in. and larger

sizes be attempted force by impact may be necessary.

In order to secure the fullest result in grinding, the character of the pulp should be such that no segregation of parts can occur; coarse sands, fine sands and the water should remain evenly mixed, then all sizes get an equal chance of entering the grinding zones. With dilute pulps the coarse sands separate and settle to the bottom, where they come into close contact with the pebbles. The fine sands tend to be held in suspension, float up in the main body of the mill, and get only casual contact with the pbbles. With pulps of around 30 per cent moisture no segregation of parts takes place—the whole pulp clings to the surface of the pebbles, is carrried along with them throughout their travel, and gets every opportunity for being caught in the grinding zones. There will be less floating load in the body of the mill as most of the pulp will be traveling with the pebbles. It will probably cause an unbalanced load and require more power to turn the mill, but there will be no cushioning of the grinding forces if "cascading" be practiced—every pebble works every moment. I think that with cascading of the pebbles 90 per cent of the grinding done is accomplished by abrasive force exerted between the pebbles in the bottom of mill and on the uphill movement. With 38 per cent moisture no clinging of the pulp to the pebbles can occur; sands settle out quickly and are ground while in the bottom of the mill, the fine product then rising to float in suspension with the main body of the pulp.

Method of Feeding.

Scoop-feeding solved all the troubles incidental to charging thick pulps into tube-mills; low discharges solve those incidental to passing thick pulps through tube-mills. Thirty per cent moisture pulps will not flow freely in launders, but screw conveyors will pass them. Thirty per cent pulp comes out of the tube-mill as a thick ooze, lining the chamber 2 in. thick, but this can be diluted by a hose playing on the outside of the cylindrical screen. We found that 25 per cent moisture pulp would work through a mill having 18-in. discharge end, but could not maintain an even flow with as much tonnage as the mill would fully grind; we could maintain the flow for hours at a time, long enough to determine to our satisfaction that such low moisture would be desirable if we could overcome the mechanical difficulties of handling it. We thought that with lower discharge we could have obtained the tonnage desired, and with open circuit. With 30 per cent moisture we could maintain an even flow of pulp, but the tonnage desired could not be reached, though we did obtain better than 80 per cent through 200 mesh.

According to the experiments of W. B. Easton, with a mill equipped with lifter devices he obtained 70 per cent through 200 when passing 144 tons through it with open circuit, and with 240 tons gross, closed circuit, he obtained 72 per cent through 200 mesh. These are figures that I believe have never been equalled in tube-mill practice. I would take it that the moisture contents were 38 per cent and 40 per cent, and would like to have seen his results when passing pulp of low moisture. His experiments would indicate that, with low discharge, sufficient feed of any moisture can be passed through a mill in quantity to overload, and that consequently the closed circuit cannot be dispensed with entirely; but when net grinding to minus 200 reaches such figures as 70-odd per cent it would seem that it would be better to work one perhaps two tube-mills, following in series to take the concentrated return from all the primary mills.

The figures given by Mr. Easton concerning minus 200-mesh product are all in conjunction with 38 per cent and 40 per cent moisture pulps; we would like to have had some of his figures or results of passing low-moisture pulps. His comments on low moistures would infer that he favored them for their grinding effects; he declares himself in favor of them as regards their requiring lower power consumption, and he also states that fuller load develop lower consumption. I am inclined to think that the effect of the lifters will be to extract the top of the floating load in the mill first, and thereby lower the moisture content of the charge of pulp in the mill at a given moment. I consider the lifter device the greatest improvement in tube-mill design that we have seen in a long time.

Metallurgical Investigations.

The "Consulting Metallurgist and Metallurgical Investigations" is the title of an article by Mr. W. B. Blyth, published in the Proceedings of the Australasian Institute of Mining Engineers. The article relates to the work of the consulting metallurgist in the cyanidation of gold and silver ores, and gives many pertinent suggestion regarding the testing of ores, designing and operation of plants, and investigation of existing plants. In addition to technical data, the article contains much wholesome advice. A few of the important matters are here briefly reported.

The author points out the difficulty of interpreting probable commercial results from small scale tests, but adds that "common sense, resource and dependable apparatus are the most valuable assets in comparing work of this nature."

Attention is called to the necessity for co-operation between the mining, the mechanical and the metallurgical engineer, in order to get the best economic results and to safeguard the investigator in matters on which he is not expert. In order to avoid future misunderstanding with the directors of a company it is well to limit the anticipated extraction to a given tonnage, so that future overloading of the plant, with its attendant lowering of extraction, cannot be made to reflect on the investigator.

In testing for the treatment of raw sulphide ores and concentrates dry crushing will give faully results for the following reasons:

(a) That dry crushing and screening is positive crushing, and the softer particles of high specific gravity are not necessarily crushed finer than the hard particles of low specific gravity. Consequently, although screen test may show that the whole product is fine enough, yet in reality the gangue particles are probably too fine and the sulphide not nearly fine enough. The percentage of colloids in a sample crushed wet to pass a 150-mesh screen is enormously in excess of that in the same sample crushed dry.

(b) An excess of abraded iron is produced in dry crushing, and the heat generated expedites oxidation in sulphides that are liable to rapid oxidation—both disastrous factors, under certain conditions, to subsequent treatment."

It is pointed out that abraded iron is innocuous if the solution is kept alkaline with CaO and no heat be generated. Once oxidized, however, the iron precipitates ferrous hydroxide with lime, and ferrocyanide is formed. The resulting conditions are such that good results are impossible. Ferrocyanide in itself is harmless, but its presence suggests that poor conditions have existed or do exist. Graphite is without effect except that it acts like oil in the flotation process and surrounds mineral with a scum which prevents extraction. The effect of pyrrhotite is not clearly understood. In some cases it acts as a precipitant.

Much stress is laid on the preparation of the sample on witch tests and assays are made The metallurgical engineer is urged to know for himself the nature of underground conditions, the quality and quantity of ore, and the collection of the samples. "Expecting sharp criticism from mining engineers, perhaps few are competent to select, unaided, a representative sample from a mine for the purpose desired."

Discrepancies between laboratory and plant roasting are discussed at length. Time is believed by the author to be the most notable factor in these discrepancies. In a comparative test he found that whereas ore remained in a furnace for several hours, attaining its temperature gradually, a muffle roast in the laboratory is complete in 45 minutes. His apparatus and method for getting comparative results are as follows:

"A cast-iron dish 4 in. deep divided into two compartments, is made to closely fit into an ordinary wind assay furnace fired with coke. The fire is started and the shaft filled with cold coke, well rammed. The cast-iron dish is then placed in position on top of the fire and the edges packed tight with small coke. A charge of the ore to be tested is placed in one compartment (1000 grm.), while a charge of an ore on which dry-crushing and cyaniding results are already proved is placed in the other. The draught is kept well back, and the heat gradually raised with constant rabbling. In about 39 min. sulphur should commence to come off, and this should all be off in two hours. After two hours the heat can be raised as much as possible, and finally the lid of the furnace is closed for about 10 min. Rabbling must be carried on carefully all the time, as any fritting precludes success. If subsequent cyaniding experiments on the ore (on which the process is proved) give plant results, then the results obtained on the new ore may be accepted as reliable. By this means the writer has obtained reliable results which have been borne out in the plant."

Amalgamation tests on a small scale cannot be relied upon, and inasmuch as amalgamation plays such a relatively unimportant part in cyanidation nowadays, the author prefers merely to amalgamate in a pan for the removal of coarse gold and not to indicate what saving can be made by that process.

Leaching tests usually give dependanble results. They should be made in a high column, say, 6 ft., and aeration of the sand and solutions should be attempted.

The determination of the slime-settling rate is an important matter. The author has elaborated a standard slime-settlement chart, based on tests conducted as follows:

"Two 1000 cc measuring flasks were obtained of similar height (15 in.). A 15 per cent pulp of the slime to be tested was introduced into the flask. The pulping medium tested 0.05 per cent KCy and 0.013 per cent CaO; 15 per cent was determined on as representing a fair plant thickness. The test was conducted on the sample slime from a number of different mines which had efficient settlement plant already installed. The settlement test was conducted in each case under identical conditions with regard to the determining factors, but the particular mine water was used in each case. There are mine waters varying from 0.1 per cent to 26 per cent of solids in Western Australia, and this is a factor of great importance in making settlement tests. Settlement was allowed for one hour in each case, and two tests were conducted—one in the alkaline cyanide solution already described, and the other in the ordinary non-alkaline mine water. The diagram shows the tests conducted in the alkaline solution only. The diagram is of considerable value in designing plants, as, knowing the settlement area for a given tonnage of slime on the mines illustrated on the diagram, it is only necessary to compare a settlement test conducted under similar conditions to arrive at the settlement area required to do definite work on the ore under examination."

Referring to new processes designed to supplant proved methods, the author wisely observes: "Let the old-established producing mine do the experimental work. The new producer has too much at stake to take any chances."

In making vacuum-filter capacity tests care must be taken to filter the product in exactly the same condition experimentally as it will be obtained in the plant. The question of replacement of pregnant solution with wash solutions is a criterion of the work. A good way to conduct these tests is to take a series of solution samples from the vacuum pump discharge every minute during the wash. When the assays are arranged in graphic form they show the replacement of gold solution by barren wash, and when two washes are used the replacemente of barren solution by water is indicated.

Special attention is directed to the assay of slime residue and the probability that such assays will be faulty unless the greatest care is exercised. The losses which may occur in drying the sample, especially the losses of dissolved gold in the residue, are remarkable. This point was touched on at some length in this journal, February, 1915, page 119. The use of precipitants is advisable before drying and assaying. Cuprous chloride or Whitby's mixture (copper sulphate, sodium sulphite and sulphuric acid) are suitable precipitants.

In estimating working costs after having determined the economic solution of the extraction problem, the metallurgist should lay out the flow sheet in detail and estimate treatment costs. The type of plant required must be determined by sketching out in detail all the possible economic alterations. Then detailed treatment costs should be prepared, and a balance sheet made showing the net result of each alternative scheme. "Cost estimate can only be safely entrusted to experienced and conservative operators." Fixed and variable costs must be considered, especially the latter, as they vary with each individual ore.

What is a Placer?

A placer is an unconsolidated deposit accumulated by mechanical processes, carrying one or more minerals in commercial quantities. All placers are secondary deposits—that is, the material of which they are composed was originally derived by erosion of bedrock. Although it is undoubtedly true that under certain conditions nuggets of placer gold have been enlarged through chemical precipitation, yet this action is a negligible quantity in placers. Placers may be derived solely by rock weathering without water sorting, but more commonly are the result of water transportation, sorting, and deposition. Many of the richest placers are those formed by the erosion of older placers and the reconcentration of their gold.

Oil Displaces Coal.

Owing to the great output of petroleum in California and its use as a manufacturing, railroad, and steamer fuel, the production of coal in Washington has been considerably reduced during recent years. It is estimated that the consumption of California oil for fuel on the Pacific Coast is equivalent to about 21,000,000 tons of coal, or between 6 and 7 times the output of coal in Washington, or for that matter in all the Pacific Coast States combined, in 1914.

Notes on Flotation.

By J. M. Callow, Salt Lake City, Utah.

The sclective action of oils for lustrous minerals was first disclosed by Haynes in 1860. In 1885, Miss Carrie Everson elaborated this idea and also disclosed the fact that acid increased the so-called selective action. Her patent called for oils, either animal, vegetable or mineral, also for an acid or salt. The process was tried out on a practical scale in Baker City and Leadville, in 1889, and failed: first, because, as has since been shown, of the unsuitability of the ore to flotation; and second, because the invention was too far in advance of the times. Then followed the Elmore brothers, first with their bulk oil processes and later with their vacuum method. The basic principles of oil flotation were undoubtedly covered by the above inventors, the work done since their time being merely a building up on ground work laid by them. Different kinds of oil, different quantities of oil, and the varying degrees of agitation, were all exemplified and practiced by them in one phase or another, and the developments that have since been made are but elaborations of the fundamental principles laid down by Haynes, Everson, and the Elmore brothers.

In 1902, the Potter-Delprat process was developed in Australia. In this process no oil was used, the mineral being raised by the generation of gas, brought about by the introduction of acid into the pulp. The mineral particles appeared on the surface of the separatory vessel, in the form of a scum or froth, buoyed up by minute gas bubbles attached to them. This no doubt first gave the suggestion of gaseous flotation.

In 1902, also, Fromont, an Italian, was granted a patent in which he combined violent agitation with oil and gaseous flotation, the gas being generated within the pulp, in much the same way as in the Potter-Delprat process.

In the same year, Cattermole came out with a unique method. First, the pulp was emulsified with a small quantity of oil, by violent agitation, and then submitted to a slow stirring action in a second machine. This granulated, or coagulated, the minerals that had been oiled into nodules which were afterward separated from the pulp by gravity. The defect of this process was that only part of the mineral granulated, the rest of it appearing on the surface of the pulp as a scum or froth, and so was lost in the tailings. This defect of the Cattermole process suggested the fundamental idea of the process afterward described by Sulman, Picard, and Ballot in their patents, in which, instead of granulating part of the mineral, all of it was floated. This patent forms the basis of all the Minerals Separation operations. It was first exploited in Australia and in a short time replaced all other flotation processes in that country.

In 1904, MacQuisten brought out his ingenious tube process, which gave excellent results on the sandy portions of the feed, but was inoperative when slime was present. This was a strictly surface-tension method, and its inability to handle slime was a serious limitation.

In 1912, Hyde introduced a modification of the Minerals Separation process into the mill of the Butte & Superior Co., Butte, Mont. This differed from the regular practice in that roughing and cleaning of the concentrates were done.

*From a paper to be read before the New York meeting of the A. I. M. E. February, 1916.

Callow Pneumatic Flotation Process.

Early in 1909, I did a great deal of work with the MacQuisten flotation process, and was intrumental in the tube-plant installation at the Morning mill at Mullan, Idaho. This work was followed by a large amount of experimenting on the different kinds of existing flotation processes, the outcome of which was the development of the pneumatic process.

The first application of pneumatic flotation for the treatment of ore was made at the mill of the National Copper Co., at Mullan, Idaho, which was designed and built by me. Construction was started on Aug. 14 1913, and the plant went into operation about Apr. 10, 1914. It was a metallurgical success in every way from the start.

Since that date, the process has been adopted by nearly all the other mills in the Coeur d'Alenes treating lead and lead-zinc ores, notably the Gold Hunter, Morning, Hercules, Bunker Hill & Sullivan, Caledonia, Last Chance, Hecla, Standard, etc., a total of about 50 cells in all, treating from 1,500 to 2,000 tons of slime and fine sand feed per day. The same process too has since been adopted by the Inspiration Copper Co., the Arizona Copper Co., the Anaconda Copper Mining Co., the Magma and other copper companies, and by the Silver King, Daly-Judge, Duquesne, and El Rayo mining companies, on lead, zinc and other ores, making a total of some 680 cells operating, or in the course of installation, having a combined capacity of about 25,000 to 28,000 tons per day.

In the mixer operated by compressed air, the oil, air, and water are mixed and emulsified, the same type of apparatus being in common use in cyanide works. In cases where the oil, or frothing agent, can be fed into the crushing machine or tube mill, this mixer, or Pachuca tank, can be dispensed with, the tube mill discharging direct to the separatory cell.

It has been conclusively proved that agitation per se is not necessary to successful flotation by the pneumatic method. In one of the plants a Pachuca mixer for each four roughing cells was installed. The pulp from a Dorr thickener was delivered to the Pachuca by a belt-and-bucket elevator, the oil being fed into the boot of the elevator. It was found that the mixing obtained in the elevator alone gave as good results as when the Pachucas were used; so the use of Pachuca tanks in this plant was abandoned.

The initial or roughing separatory cell consist of a tank about 9 ft. long overall, and 24 in. wide, with a bottom inclined at from 3 to 4 in. to the foot; it is 20 in. deep at the shallow end and 45 in. deep at the other end. It may be built of either steel or wood, but wood construction is preferable.

The bottom of the tank consists of a porous medium made of four thicknesses of loosely woven canvas twill, properly supported by a backing of perforated metal to prevent its bulging when under air pressure. Through this porous medium compressed air is forced by a blower. Porous brick, or any other ceramic material that will give the necessary fine subdivision to the air, may also be used. Some of these have been tried out, but for practical and mechanical reasons the loosely woven canvas twill seems to serve all purposes better than anything else, and has been adopted as the standard porous-bottom construction.

The space underneath this porous medium or bottom is subdivided into eight compartments, each connected by an individual pipe and valve with the main air pipe. By this means the air pressure to each compartment can be regulated (by throttling the valve) to correspond to the varying hydraulic head within the tank, and so as to discharge a uniform amount of air throughout the length of the bottom and maintain a uniform aeration of the contents. A pressure of from 4 to 5 lb. is generally used, each square foot of porous medium requiring from 8 to 10 cu. ft. of free air per minute.

Each longitudinal edge of the tank is provided with a lip and an overflow gutter for the reception of the froth to be discharged. The lower end of the tank is furnished with a spigot discharge fitted with a plug valve, operated by a float, to maintain a uniform water level within the tank and thus, in turn, maintain a uniform and constant discharge of froth under all the varying conditions of feed supply incident to practical milling operations. The water level may, of course, be varied, but is usually maintained at about 10 to 12 in. below the level of the overflow lips.

The tailing is discharged through the spigot and the frothy concentrate is conveyed by means of the side gutters to the pump and thence to the cleaner separatory cell. This cleaner cell is a machine of the same construction as the rougher. In operation, however, it is usually run with a lower air pressure than that used on the rougher. The tailings from the cleaner is returned by pump to the original feed, a closed circuit thus being maintained on this portion of the feed. The concentrate from the cleaner is the shipping or finished concentrate.

Usually one cleaner serves four roughers.

Cells May Be Used in Parallel or Series.

The machines may be run either in parallel or in series without any sacrifice in the capacity for a given number of cells. Recent experience goes to show that on some ores the series treatment gives a slightly cleaner tailing; on others it does not. It is not necessary to extend this arrangement of cells beyond two cells in series. In a heavily mineralized ore this arrangement is decidedly advantageous, and in such a case the rougher concentrate might be of high enough grade to dispense with the re-cleaning operation. The froth from the second cell in the series might be returned to the original feed in the same way that the tailing is returned from the cleaner when practicing a roughing and cleaning operation. A number of such combinations are possible.

At the mill of the Inspiration Copper Co., the original roughers go to four cleaner cells, and the tailing from which is classified into sand and slime, the sand going to tables and the slime to 12 secondary roughers. The concentrates from both the primary and secondary roughers go to four cleaner cells, and the tailing from the cleaner cells is pumped back into the circuit.

The froth is generated as the result of injecting the finely divided air into the bottom of the already emulsfied pulp; it continues to form and to overflow so long as it is furnished with pulp of the proper consistency, adequately mixed with the right quantity and kind of oil or frothing agent. Measured from the water level within the tank, the froth produced may be from 14 to 16 in. thick and will be more or less voluminous, coarse or fine grained, dry or watery, according to the character of the ore and the kind and quantity of oil introduced. The condition of the froth may be varied therefore, by changes in the kind and quantity of oil used, and the quantity of air injected.

In some ores, rich in sulphides, and where a comparatively low-grade concentrate will suffice, the cleaning cells may not be necessary, but on low-grade ores having a high ratio of concentration and when a concentrate of extreme cleanness and of maximum grade is required, a cleaner is desirable.

Pulp Density.

The pulp to be treated may be of varying density, from 2½ of water to 1 of ore, up to 5 or 6 to 1. For a mixture of sand and slime, the former ratio is preferable, but for a pure slime mixture (minus 200 mesh) the larger proportion of water is allowable. The particular density is not a matter of as much importance as the supplying of pulp of uniform density, since each variation in the density of the pulp requires a readjustment of the oil supply, the quantity of oil increasing in proportion to the increased volume of the pulp, independent of its soild contents.

A normal capacity for each standard roughing cell is 50 tons per 24 hr. This, of course, will vary according to the nature of the ore. In one plant which practices gravitation previous to flotation, only the fine sand and slime being treated, the rate is 50 tons per rougher cell. The Inspiration Copper Co. practices flotation as the prime process, each 800-ton section employing 24 roughing cells and four cleaners. The cells in this case are run in series, the primary cells treating original feed and the secondary cells treating only the slime from the primary tailing after the sand has been removed. This gives an average of 33.3 tons per roughing cell. The Arizona Copper Co.'s plant will treat the slime and re-crushed sand from previous gravity treatment; out of an original tonnage of 4,000 about 3,600 tons will be treated by flotation. This will be handled on 63 roughers run in parallel, and 18 cleaners, or an average of approximately 57 tons per roughing cell, or 45 tons per cell for roughing and cleaning.

Some tests have shown little difference in recovery, whether running 45 tons to the cell or 65; but that the recoveries commence to decline as soon as the tonnage exceeds 75 tons. In the Coeur d'Alenes, on zinc-lead ores, 35 tons per cell is an average capacity.

Oils Used.

The oils used may be broadly divided into "frothers" and "collectors." The pine oils are good frothers and coal tar and its various subdivisions are good collectors. On some ores, crude pine tar will in itself combine the properties both of frothing and collecting; on others, this may have to be enriched by the addition of some one of its more volatile constituents, such as refined pine oil, turpentines, or wood creosote.

Generally speaking, the coal-tar products are poor frothers, and to get a sufficient volume of froth to insure a high recovery it is often necessary to add refined or crude pine oil, creosote, etc. At the Inspiration mill, for instance, the mixture is 80 per cent, crude coal tar, 20 per cent. coal-tar creosote; at another plant on similar ore 45 per cent, El Paso coal tar, 40 per cent. coal-tar creosote, 10 per cent. creosol, and 5 per cent. pine oil. At Daly-Judge a mixture of 40 per cent. crude coal tar, 40 per cent. creosote, and 20 per cent. pine oil was used. In the Coeur d'Alenes on zinc ore straight wood creosote was used; on the ore of the National Copper Mining Co., plain turpentine will work, but pine oil is better.

At Inspiration, from 1½ to 2 lb. of the mixture per ton of ore was used; at Daly-Judge, 1 to 1½ lb.; and at the National 0.3 lb. of oil is sufficient. In the experimental work at another plant the oil consumption was approximately 1 lb. of mixture per ton; but since the entire plant has been in operation, and the circuit water reclaimed and used over again, the oil consump-

tion has dropped to 0.35 lb. At present the proper kind or kinds of oil and the requisite quantity can only be determined by experiment; no scientific way has thus far been found.

The froth made by the pneumatic process has the distinctive characteristic of being unstable or ephemeral; that is, it quickly dies when removed from the action of the injected air. The bubbles composing the froth are generated under a hydraulic pressure varying from 15 to 40 in.; upon rising above the water to the froth level, the bubbles burst by reason of the lower pressure of the atmosphere. On bursting, they release the mineral attached to them, which is caught up by the bubbles folllowing immediately behind. The stability of the bubbles depends to some extent, upon the oil used and the nature of the gangue in the pulp treated. Pine oil makes a brittle froth which dies immediately on arriving at the surface. Creosote and light oil make a more elastic envelope which at times will expand into bubbles 3 to 4 in. in diameter before bursting. Pine-oil bubbles are rarely over ¼ or ½ in. in diameter. Castor oil, olive oil, candle-makers' oil (oleic acid), palm oil, sperm oil, and other oils of a lubricating nature, have in general been replaced by oils more or less soluble or miscible in water—such as turpentine, pine oil and all the coal and wood-tar distillations. The extremely volatile oils such as naphtha, gasoline, ether and alcohol, seem to be of little use except as means for making the pitchy ingredients of coal and wood tars more soluble or miscible.

A large coarse, and elastic bubble seems necessary to the recovery of coarse-grained mineral, but for the very fine and colloidal mineral, a small and comparatively brittle bubble is necessary.

Power.

The National Copper Mining Co., using approximately 950 cu. ft. of air at 4-lb. pressure, and treating 500 tons per day on eight roughers and two cleaners, required 35 hp.; this shows a requirement of 3.5 hp. per cell, equivalent to 12.53 tons per horsepower or 1.25 kw.-hr. per ton.

Another company using approximately 9,699 cu. ft. of air at 5-lb. pressure and treating 2,400 tons per day on 48 roughers and 12 cleaners, requires 210 hp., equivalent to 3.5 hp. per cell, 11.45 tons per horsepower, or 1.56 kw.-hr. per ton.

The experimental plant of the Inspiration Copper Co., using approximately 950 cu. ft. of air at 5-lb. pressure and treating 200 tons per day with four roughers and one half-size cleaner, required 24 hp.; deducting 4 hp. for two 2-in. centrifugal pumps the figures become 4 hp. per cell, 10 tons per horsepower, or 1.79 kw.-hr. per ton.

A maximum figure would be 2½ kw.-hr. per ton of feed, using 5- to 5½-lb. air pressure, generated by Roots or Connersville positive blowers.

Summarized, the estimated cost on a 2,000-ton flotation plant, or larger, would be in cents approximately as follows:

Labor	1.25
Oil	2.50
Maintenance	0.50
Power	2.50
Total	6.75

On a plant of 250 tons the extra labor cost per ton would bring it up to approximately 10c. per ton of flotation feed.

Actual figures from a large plant treating over 2,000 tons by flotation gave 6.1c. per ton; the flotation feed in this case represents 60 per cent. of the crude-ore tonnage, making the cost 3.5c. per ton of crude ore treated.

*Sampling an Erratic Orebody.**

By L .A. Parsons.

In February last there appeared an interesting article by Mr. Morton Webber on 'Latent Errors in Mine Sampling.' In this article Mr. Webber classifies the type of erratic ore occurrence, in which the valuable mineral occurs in bunches, under the general heading 'Mines where sampling is no use,' and recommends the mill test as the only reliable method of valuing such mines. To quote: "The only method of reliable valuation in a deposit of this type would be based on authentic record of past yield, in combination with competently selected representative shipments of the remaining ore."

With this I cannot altogether agree. Authentic record of past yield is of the utmost value, but I believe that this is much better studied in combination with proper sampling than with mill tests. I do not refer to those tests made to determine metallurgical treatment, or to those made over an extended period of time to confirm sampling results, and which amount to operating the mine under option, but to the mill tests designed to take the place of sampling because considered more reliable—"representative shipments." These practically amount to large samples, and my contention is that they are no more justified in an erratic mine than in a uniform one; rather less so, if anything, for the chances of error are greater, and the safety resulting from averaging a large number of samples is needed. Before discussing this further, I shall describe briefly the mothods used and results obtained at one mine of this type that I had the privilege of sampling and studying in great detail for a period of two years. This mine forms an excellent illustration of this type of deposit, and of some of the principles that affect the accuracy of the results when sampling by the ordinary hammer-and-moil method.

*From The Mining Magazine.

Irregular Ore body.

The formation at the mine in question consisted of highly metamorphosed sediments and igneous rocks, carrying irregularly scattered lenses of gold-bearing quartz ranging from almost microscopic size to several feet in thickness. These schists without quartz would assay from nil to about 3 dwt., averaging less than 1 dwt., and the quartz from nil to several hundred pennyweight. Frequently the gold was in coarse flakes, making most brilliant showings. The stringers, in combination with the richer portion of the schists, formed erratic ore zones separated by comparatively large zones of waste, and showed no consistency, taken either singly or in groups of any size. There was no habit or condition that could be discovered affecting

the sudden changes from spectacular ore to practically barren waste. Mr. Webber mentions levels 30 ft. apart giving erratic results. I remember one cross-cut, sampled by a continuous channel along each wall, of which, over a distance of 200 ft., one wall averaged one-third of the other. These walls were perhaps 5 ft. apart.

The troublesome nature of the ore was evidenced wherever samples were used: in the assay office, duplicates would not check at all unless ground to 200-mesh; in the mill, samples of battery pulp over a month would not check amalgam plus cyanide heads. The amount of underground development was hardly greater than would have been necessary to stope a uniform deposit of the same size, and very different from the network that Mr. Webber states to be necessary for deposits of this type. Levels about 80 ft. apart, and drifts and cross-cut about 150 ft. and 75 ft., with of course local modifications for all of these, is not a large development proportion. In fact, per ton of ore blocked, it is small. According to my opinion these conditions formed as extreme an example of Mr. Webber's classification and as difficult a problem as one would be likely to run across. And yet this mine was sampled and ore blocked out, and is being sampled today. The results are of the utmost value, both to the men financing the property and to the management planning exploration and development work. It "had" to be sampled. There was no other method of working it intelligently.

Method Employed.

The method of sampling did not differ in any essential from that in general use by a large number of engineers, so a brief description of this should suffice to make it clear. As neither the quartz stringers nor the ore zones had any definite trend, samples could have been taken in almost any direction. For ease in sampling all channels were cut horizontally about breast high along the sides of the drifts and cross-cuts. (A distinction was made between drifts and cross-cuts according to their relations to the stopes, but structurally they were the same). Both sides were sampled, as so little was known about the deposit at first that all the information obtainable was needed. These channels were the usual kind cut with a hammer and moil, and yielded about 1.5 lb. per ft. The rock surface was first cleaned with a scrubbing brush, and the channel, about 3½ in. wide, outlined with chalk. The samples were caught in an ordinary iron meat pan about 12 by 18 by 2 in. This was more easily cleaned than a candle box or canvas, and made possible a more detailed examination of the sample as it was cut.

In the low-grade or barren schists, samples were taken up to 60 in. long but in ground which was apparently rich no sample was taken more than 30 in. long. This was in uniform rock. With every change in the character of the ground the sample was bagged and a new one started. In small quartz stringers this would frequently give samples not over 3 in. long. In such cases the size of the channel was always increased to make the total weight of sample not less than 2 lb. Quartz containing the coarsest gold was not avoided in any way, but everything within the outline taken as mechanically possible. Any adjustment necessary was made in the office afterward.

Unusual Assays.

The question of high assays was of course always coming up. The first step in their treatment was re-sampling. All places yielding erratic assays were re-sampled in the bottom of the original channel. The decision as to whether an assay was erratic or not did not depend so much upon its tenor as upon that of its neighbours. An assay of 10 dwt. in one place might mean a re-sample and in another one of 50 dwt. be let go. The two or three assays of the same place thus obtained were averaged and the resultant tenor entered in the records with no reduction. At the times of calculating the ore reserves, when studying the relation of each sample to all the others, it occasionally seemed advisable to cut down an assay to a tenor more consistent with the apparent structural importance of the rich spot yielding the sample. In addition to this, an arbitrary high figure of 500 dwt. was adopted, to which all assays above tha tfigure were reduced. There were so few assays higher than 500 dwt. that it was thought they would affect the average out of proportion to the probabilities of their being duplicated in the intetrior of the blocks. These two causes combined affected a negligible proportion of the assays—probably less than one tenth of one per cent—and it is merely to show the methods of work that they are mentioned here.

In connection with the re-sampling an interesting fact was observed: the majority of times the re-sample gave a lower result than the original. I think the reason for this is clear. The occurrences of rich specimen ore were on the average so small that it was probable a large proportion of such an occurrence would be cut away by the offending sample. Similarly, I have no doubt that re-samples of the promising looking ground which had returned low assays would have given on the average higher results than the original. The averaging of the two assays thus introduced a slight factor of safety.

A System of Averages.

It will be evident from what I have said regarding the size of the rich zones that any attempt to mine them separatetly would have been absurd. The only feasible project was to take all within the mineralized zone. Therefore, in valuing ore blocked by the sampling results, the ground was considered as a lowgrade mass, and no attemps was made to segregate tonnages for the small rich zones. This resulted in a method much the same as would have been used for a more uniform deposit.

After the few adjustments of the high assays had been made as described above, the ground was divided into areas as indicated by the horizontal workings, and each area valued by dividing the total inch-pennyweights of the periphery, high and low alike, by the total sample length in inches. The blocks between levels were valued by weighting the tenor at each level by the area blocked. Rises in general were used merely to prove continuity of ore, although occasionally their tenor was averaged with that of the levels. The final result was adjusted according to knowledge of the mine. Bore-hole results were of great assistance in this, although used entirely for information as to continuity and not for obtaining the tenor; and as mining progressed the samples from the development were supplemented by moil samples from the stopes. The latter were averaged with the development samples when practicable.

The results of this method were highly gratifying. For a period of two years, the tenor of the total ore mined as indicated by moil samples, when compared to amalgam plus cyanide heads for a quarter of a million tons milled, indicated a sampling factor of 112 per cent. I regret that I am not at liberty to give figures in greater detail, but think these will illustrate my point. It may be contended that these results indicate nothing, because the work was done by the mine staff, who brought their intimate knowledge of the mine to the final interpretation of the results. This was undoubtedly a factor,

but it was a factor dependent upon experience and not upon any lessening of the difficulty of the work. Any independent engineer with sufficient experience could have arrived at the same results. In fact, in the early history of the mine, an examination was made by an independent engineer who predicted almost exactly what would occur.

The above example illustrates certain principles that I think can be applied in a greater or less degree when sampling any erratic deposit. Although it is an axiom in mine valuation that every mine must be judged on its merits, according to the experience of the examining engineer, and no hard and fast rules can be laid down, still I think these principles from a good foundation for working and are certainly of more general application than considering sampling utterly unreliable and not using it for the data that it can give. I shall try to state these principles as I see them, omitting the actual manipulation of the sample, precautions against the increased danger of salting oneself, and details of that nature as being sufficiently taken up in the short description of actual practice above.

Small Blocks and Small Interval.

Two much discussed methods for increasing the accuracy of the results on such a deposit are decreasing the sampling interval and cutting the ore into small blocks. I do not believe that either of these is exactly the remedy. What is desired in sampling is to obtain sections of the orebody which are representative of its tenor as a whole. It is obvious that if the development openings are not thus representative, no amount of close sampling will increase the accuracy of the final result; it will merely increase the accuracy of the tenor assigned to those development workings. Therefore the sampling interval need only be small enough to give the tenor of the workings to a degree of accuracy consistent with their representation of the mine as a whole.

Decreasing the interval below this point adds nothing. As for cutting the ore into small blocks, this will increase the accuracy of the estimate for each block, and therefore for the entire developed portion of the mine; but is that exactly what we are after? In most cases the maximum amount of development that can be done is more or less a fixed quantity; compressor capacity, shaft or tunnel capacity, and cost limitations all contribute to this. The development that is used to cut already developed ore into smaller blocks is not exploring the mine for extension; and it is the results of this exploration that more than compensate the engineer for the lessened accuracy of each single block. To put it differently: the smaller the blocks, the more nearly accurate is the tenor assigned to the ore thus outlined; but if we grant that this ore is only a small portion of the whole, then the larger the blocks, that is, the more the development is spread out, the more representative of the whole this devolpment will be. There must be enough samples for the law of averages to work, for the high assays to represent what will, on the average, be found in the interiors of the blocks. As shown above, obtaining this number by decreasing the sampling interval avails nothing; the samples must be from representative development. Therefore the accuracy of the result when sampling an erratic mine depends most upon the total amount of development in the ore, not the amount per ton, and the blocks need not be smaller than would be required for mining.

Relative Accuracy.

The question of valuing by sampling a mine where the values are like "plums in a pudding," as it has been so aptly phrased, compared to the mine where values are evenly distributed, is not one of impossibility, but of relative accuracy. The error will be larger than with a uniform deposit, but as long as the probable limits of error are known, the results will often be as useful as if they were more accurate. Within these limits of error, by working according to the principles outlined above, ore can be blocked out as in the uniform deposit. However bad conditions may be, they will affect the mill test more than they will sampling. Certainly I know of no method of making a mill test on the mine I have described that would have yielded information at all comparable for accuracy with that obtained by sampling. Two years' actual production gave no indication of what the tenor of the mine as a whole would be; yet the current sampling indicated it after the mill had been running six months. It was over two years after a certain tenor had been predicted

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by sampling before the mill results began to conform to that tenor. The reason for this is perfectly obious: the stoping was not done from representative places. Representative—that is the crucial point. Unless a man is clairvoyant, there is no method of obtaining representative shipments. An if he could select the proper places, a few holes one way or the other by the machine men would entirely alter the tenor of the test. It comes right down to the old question of a few very large samples versus an enormous number of small ones—a question that has been many times discussed. Obviously, I am an advocate of small samples. It is hard for me to see any advantage in a few large ones that can compensate for the effect of averaging a quantity of small ones taken with machinelike impartiality all over the mine.

It seems to me that often such stress is laid upon great precision in mine sampling and valuation that sight is lost of large issues that are more vital. Some of these have been outlined above, such as spending time and money on work whose sole object is to gain greater precision in the tenor that is assigned to the ore, rather than spending it on exploratory work that would give much needed information as to the future of the mine. And certainly this striving for great precision has no more serious consequences than when it prevents an engineer from giving any opinion as to the value of a mine, because its character is such that the results cannot be accurate within the limits of error he has assigned himself.

The erratic mine is the most difficult problem the examining engineer has to face, but that does not alter the fact that it must, upon occasion, be faced. To reduce high assays sweepingly for no reason except custom, or to refuse to place any reliance upon sampling through an excess of conservatism is to side-step the issue. The best opinion obtainable on the value of this type of mine is that honestly given by an experienced engineer without undue conservatism or optimism, after an adequate study of the mine structurally, a thorough sampling, and an analysis and correlation of the assay returns with the structural data obtained, and past yield if obtainable. To this opinion an engineer's clients are entitled.

Liquidation Plan, Guggenheim Exploration Company.

The Guggenheim Exploration Co. sent out a circular letter to its stockholders on Nov. 23, giving its liquidation plan. The letter, which is signed C. K. Lipman, the secretary, reads in part as follows:

For some time the directors have had under consideration the advisability of liquidating the business

of the company and of distributing its assets among the stockholders. It is believed that the present is an opportune time for accomplishing that purpose. The most valuable single investment of the company consists of 404,504 shares of the capital stock of the Utah Copper Co. The directors deem it impracticable to dispose of this large block of stock in the market at its fair value, and they consider it unwise to distribute it among the stockholders under conditions likely to result in a substial shrinkage in values, to the injury of all concerned.

An opportunity has now presented ifself which will enable the company to sell these shares to the Kennecott Copper Corporation on terms that will obviate these difficulties. It is proposed that the latter corporation shall purchase this entire block of Utah Copper Co. stock by giving in exchange therefor 1½ shares of its own stock for each share. The Kennecott Copper Corporation is perfecting arrangements with a syndicate which will purchase the requisite number of shares of the Kennecott Copper Corporation received by the Guggenheim company, whereby the stockholders will be enable to elect whether they desire their proportions of the proceeds of the sale of this block of stock to be distributed to them in the shares of the Kennecott Copper Corporation or in cash at the rate of $75 per share for the stock of the Utah Copper Co. so sold.

The Kennecott Copper Corporation was organized on Apr. 29, 1915, under the laws of the State of New York. It has issued 720,000 shares of stock, without nominal or par value. Its present capital is fixed at $6,000,000. On May 27, 1915, it acquired the mining claims and property in Alaska known as the Kennecott mines, and shortly thereafter there was conveyed to it the mining property in Alaska formerly belonging to the Beatson Copper Co. These constitute copper producing properties upon which extensive valuable mineral deposits have been developed. The extraction of ore has been in progress on these properties in constantly increasing volume for several years past. The Kennecott Copper Corporation has now outstanding an issue of $10,000,000 first-mortgage 6 per cent 10-year gold bonds, convertible into stock in the ratio of 40 shares of stock for each $1,000 bond. It has no floating debt except for current liabilities and for advances made against copper already sold.

The Kennecott Copper Corporation proposes, if it can do so on fair terms, to acquire additional properties and property rights, and to that end contemplates an increase of the number of its shares, which are to be issued without nominal or par value, from 720,000 to 3,000,000 shares, and of its capital from $6,000,000 to $15,000,000. The 2,280,000 of new shares are intended to be devoted to the following purposes, to the extent stated:

1. For the purchase of the 404,504 shares of Utah Copper stock owned by the Exploration company, 606,756 shares.

2. For the purchase from the respective owners thereof the shares of stock, convertible bonds and convertible debentures of the Braden Copper Mines Co., 800,000 shares.

3. For the purchase from the Alaska Syndicate of 48.174 shares of the capital stock of the Copper River & Northwestern Ry. Co., the par value of $100 each, being its entire outstanding capital stock, of $23,020,000 par value of the 5 per cent 50-year gold bonds of said railway company, being all of its outstanding bonds, and of 13,000 shares of the capital stock of the Alaska Steamship Co., of the par value of $100 each, out of a total authorized outstanding capital stock of 30,000 shares, 20,000 shares.

4. For the retirement of the $100,000,000 of convertible bonds of the Kennecott Copper Corporation, 400,000 shares.

5. For the compensation to be paid to an underwriting syndicate in consideration of the services rendered by it to the Kennecott Copper Corporation to meet the cash requirements of the proposed plan, which involves alternative offers of cash to the holders of the securities mentioned in the above subdivisions (1), (2) and (4), 65,000 shares. Total, 2,071,756 shares.

The remaining 208,244 shares of new stock and such of the shares above specified as may not be used for the purposes indicated will be available for the general corporate purposes of the Kennecott Copper Corporation.

The Messrs. Guggenheim, who are officers and directors of your company, are the owners of large holdings of the stock, bonds and debentures of the Braden Copper Mines Co. and of the stock and bonds of the Kennecott Copper Corporation. They are also members of the Alaska Syndicate, and as such are largely interested in the securities which the Kennecott Copper Corporation proposes to purchase from that syndicate and in the shares of stock of Kennecott Copper Corporation owned by such syndicate. Messrs. J. P. Morgan & Co. are likewise the holders of large amounts of the bonds of the Kennecott Copper Corporation, and are members of the Alaska Syndicate. That firm, as well as the Messrs. Guggenheim, and the directors of some or all of the corporations herein named, may become subscribers to the underwriting syndicate, when organized, and participate in its compensation.

Upon the consummation of this proposed sale of the shares of the Utah Copper Co., it is the present purpose of your directors, while retaining in the corporate treasury property exceeding in value the capital stock of your company, to make a distribution of a portion of its assets among its stockholders, as follows:

a. The proceeds of the Utah Copper Co. stock, by paying to such stockholders as shall elect to take their proportionate share of such proceeds in cash, $36.387 in cash for each share of the Guggenheim Exploration Co. and to such stockholders as shall elect to accept shares of stock in the Kennecott Copper Corporation 772.77 per cent of a share of the stock of the latter company for each share of the stock of the Guggenheim Exploration Co. held.

b. 97.750 shares of the capital stock of the Chino Copper Co., by transferring to each stockholder of the Guggenheim Exploration Co., 11.72 per cent of a share of Chino stock for each share of the stock of the Guggenheim Exploration Co.

c. 69.500 shares of the common stock of the American Smelting and Refining Co., by transferring to each stockholder of the Guggenheim Exploration Co. of 8.33 per cent of a share of common stock of the Smelting Company for each share of stock of the Guggenheim Exploration Co.

d. 154.300 shares of the capital stock of the Ray Consolidated Copper Co., by transferring to each stockholder of the Guggenheim Exploration Co. 18.50 per cent of a share of the stock of the Ray company for each share of the stock of the Guggenheim Exploration Co.

Prizes for U. S. Geological Survey and Bureau of Mines.

The preliminary list of awards by the Panama-Pacific International Exposition gives the U. S. Department of the Interior collective exhibit one grand prize. The exhibit of the Geological Survey receives one grand prize, four medals of honor, five gold medals, six silver medals, and two bronce medals. The Bureau of Mines receives one grand prize, six medals of honor, three gold medals, and three silver medals.

Mexican Views.

A Traveller for the Mexican Mining Journal.

A Mill in Western Chihuahua.

Pinguico Mill at Guanajuato.

Mexican Views.

San Rafael Mill at Pachuca.

Bringing Machinery to the Mine.

PATIO

At the Tonopah-Belmont mill welding of cam shafts with thermite has been tried. The cost per shaft was $42.53.

The Churchill Milling Co. at Wonder, Nev., has made a saving of 0.23 lb. of cyanide per ton by changing the method of washing on the Oliver filter, using water on both the ascending and descending sides of the drum instead of barren solution on the former and water on the later. In order to prevent excessive dilution of solution by this double use of water, a rubber apron is placed against the cake on the ascending side to divert the surface water to the slime-discharge launder. Similarly on the descending side an iron apron 13 in. wide was placed so that its upper edge was just above the blow-off section. This apron scraped off about 1/16 in. of the cake surface and removed considerable wash water, diverting the pulp to the usual discharge launder without interfering with the regular operation of the blow-off. This method makes it possible to keep the cake covered with a sheet of water on both sides without allowing an excessive amount to enter mill solutions.

A novelty in roughing tables is in use at Silverton, Colo., where tables 12 ft. wide and 45 ft. long are handling an enormous tonnage of old tailings which are being retreated. The feed is classified into coarse and fine, and both are fed to the same table, the coarse at the usual feed box and the fine near the discharge end. Another development in rough concentration is the use of tables in coal washing for work formerly done by jigs. The deck of a coal-washing table is 7 ft. by 16 ft. rifled horizontally over the entire surface. It is claimed that this table does more efficient work than the jig. A change in riffling has also been used in handling more effectively unclassified feed. Every third or fourth riffle is made higher than the rest so as to make a pool in which the material undergoes a sort of classification.

In ore testing the investigator should be on his guard against changes in the iron salts of the sample during the operation of the test. One of the most active ore ingredients in increasing cyanide consumption is ferrous iron. The sample may contain no ferrous iron when received but may develop this form during drying and crushing, and thus cause the results to show a higner consumption than would the material in actual practice.

The Newport Mining Co. is furnishing its miners who are sinking the Woodbury shaft protective covering for the head in the form of hard hats to prevent injury by falling rocks. Unlike the steel helmets worn in the trenches in France, the head-coverings used by the miners are made of felt treated with resin and shellac.

The use of back-geared motors is increasing, due to their convenience and inexpensive installation. They are employed when lower pulley speed is required than could be secured in direct drive from the motor. Their use eliminates the counter shaft with its loss of power, expense for installation and multiplication of belts and tighteners.

A single, standard size Pierce-Smith converter at Hayden, Ariz., turned out during the month of November, 1914, a daily average of 81 tons of copper from a 42 per cent matte. During the first half of February, 1915 it produced an average of 85 tons of copper per day.

Selective flotation for the separation of zinc from lead and iron minerals is the subject of a recent Australian patent. The patent provides for the addition to the pulp of certain mineral salts which yield a reducing gas in contact with acid. In practice thiosulphates, sulphites and bisulphites have been used. These when mixed with sulphuric acid yield sulphur dioxide gas. The action of the gas causes the zinc blende to be wetted so that it remains at the bottom while the lead iron sulphides float. The separation of the blende from the gangue is effected in a separate operation. Instead of developing the gas in the mixture it may be introduced in other ways with equally good results.

From experiments with tube-mills fitted with scoop discarge, Dr. W. A. Caldecott deduces some surprising figures. Assuming that the present average duty, under ordinary circumstances, of a standard 22-ft. by 5½ ft. mill is 120 tons of minus 90-mesh product per twenty-four hours, the performances recorded in the tests with scoop discharge showed considerable improvement, the comparative duty being 143 tons. Increase of the pebble load to a height materially above the axis of the mill is of little assistance, since the power consumption and pebble wear increase out of all proportion to the increase in quantity of minus 90-mesh product. Thus in one case, a pebble load of 16.08 tons required 20.04 hp. more to produce only 3.22 ton more than a pebble load of 12.84 tons. The most effective diameter of scoop was found to be 24 in., considering the results obtained and the wear of liner and pebbles. With larger diameter of scoop the wear is excessive. There does not seen to be any saving of power in the use of scoop discharge, but the real advantage lies in increased capacity, which is such that five mills with scoop discharge will do the work of six mills with trunnion discharge. Small sand feed decreases the yield of minus 90-mesh product; and as increased feeds up to 500 tons do not increase the power consumption, there is no reason why a large tonnage should not be fed.

Curtains of chain are now used to protect the workmen from the glare of an open furnace. The loose chain does not interfere with the manipulation of tools and the openings in and between the links gives a sufficiently unobstructed view. The heat radiation may be reduced to any desired extent by the choica of thickness and closeness of the chain mesh.

The reasearch laboratory of the University of Illinois has produced a new non-corrosive alloy which has been called illium in honor of its birth-place. The alloy was not hit upon in the usual cut and try way, but by the selection and proportioning of metals having positive and negative electrical properties. The alloy contains nine elements: nickel, 60.65 per cent; chromium, 21.07 per cent; copper, 6.42 per cent; molybdenum, 4.67 per cent; tungsten, 2.13 per cent; aluminum, 1.09 per cent; silicon, 1.04 per cent; manganese, 0.98 per cent; and iron, 0.76 per cent. Carbon and boron make up the remaining 1.19 per cent of the alloy.

Colorado is experiencing an old-fashioned "rush" to a new mining field within fifty miles of Denver. The object of the rush is not gold or silver but tungsten. Fortunes have been made in a few days and the miners see "millions in tungsten."

The Utah Leasing Co. has built a 500-ton flotation plant for treating the old dumps of the Cactus mine. The failings are collected by means of a drag line, ground in Hardinge mills and treated in Mineral Separation Co. machines. At present a mixture of light coal tar creosote and acid petroleum sludge is used as the floating agent. In general, however, better results have been obtained in an alkaline medium. An average of 80 to 85 per cent extraction of the chalcopyrite in the tailings is recovered.

The annual report of the South African Chamber of Mines for the year 1914 gives figures for purchase of cyanide and total tons of ore milled in the district, and assuming no great increase in the stocks on hand ,it may be calculated that the average consumption of cyanide was 0.40 lb. per ton of ore treated and that of zinc for precipitation 0.32 lb. per ton of ore. The annual requirement of cyanide for South Africa is roughly 5000 tons.

In tests made in the Rand district of South Africa to determine the quantity of cyanide lost by exposure to the air, it was found that both in sand tanks and in slime agitation the consumption could be reduced by 30 per cent by using the closed system instead of the usual open system. It was found that no amount of protective alkalinity is capable of preventing a loss by escape of cyanide into the air.

As a substitute for zinc shavings for precipitation from cyanide solutions a zinc ribbon has recently been placed on

the market. The ribbon is produced by fine streams of molten zinc falling upon a rotating water-cooled drum having a peripheral speed of 950 ft. per minute. The ribbon, although of about the same thickness, is much wider and more ductile than the ordinary shaving, and after having been in contact with solution will probably have a tendency to pack in the boxes.

A recent patent concerns a modification of the Blanton cam-shaft key. The modification consists in making the wedge double, the tapers of the two parts being in opposite directions, thus making a folding wedge, both parts being secured to the shaft when in action. It is claimed that a wedge of this construction is more readily released than the single wedge.

The following definition of a placer has been formulated by the Mining Press:— A placer is an unconsolidated deposit accumulated by mechanical processes, carrying one or more minerals in commercial quantities. All placers are secondary deposits—that is, the material of which they are composed was originally derived by erosion of bedrock. Although it is undoubtedly true that under certain conditions nuggets of placer gold have been enlarged through chemical precipitation, yet this action is a negligible quantity in placers. Placers may be derived solely by rock weathering without water sorting, but more commonly are the result of water transportation, sorting, and deposition. Many of the richest placers are those formed by the erosion of older placers and the reconcentration of their gold.

George F. Brooks, of the New Jersey Zinc Co., has patented a briquette for charging zinc retorts. The mixture consists of four parts of ore, crushed to the usual degree of fineness, one part of fine ore, or instead of fine ore, this quantity of zinc oxide, and one and one-half parts of coal of the usual fineness; enough common salt solution to form a pasty mass is incorporated with this mixture and the whole subjected to a pressure of 90 lb. per square inch. The briquettes, approximately 7½ in. in diameter and 7 in. long, are then dried at a temperature of 220 deg. F. The drying brings the salt to the surface as a coating through which the zinc must pass in the subsequent distillation. This, it is said, reduces the percentage of zinc fume produced and increases the yield of spelter. A further advantage is the ability to charge 15 to 20 per cent more ore per retort than in the usual way. This, together with the reduction in the percentage of blue powder formed which must be resmelted, is claimed to increase the capacity of a retort by 50 per cent.

Tin occurs mostly in the form of cassiterite and in lumps which are comparatively rich in the metal. A very simple test to determine whether a specimen of dull, dark and heavy material is tin ore or not may be made as follows. Wrap the specimen in zinc shavings such as are to be found in any cyanide mill. Soak the whole for a short time in hydrochloric acid. Remove and wash the specimen and rub vigorously on a rough cloth. If specimen is cassiterite it will take a bright metallic polish as if it were coated with mercury. The coating is metallic tin reduced by the zinc and hydrochloric acid.

The Dalmatia mine in California seems to have made a record for low cost of mining and milling. The ore is broken down in open cuts, carried down a chute to a lower level and trammed to the mill bins. The mill has ten stamps and a Huntington. The cost of delivering ore was 10 cents per ton, and milling 33 cents, or a total of 43 cents for both mining and milling. It may be questioned whether this included an allowance for the cost of installation.

It requires a weight of 0.0724 gram per sq. cm. to overcome the surface tension of pure water or to just break the surface membrane. Taking into consideration the size and shape of the particle, it is therefor possible to calculate approximately the weight of a mineral not wetted by water which may be supported in surface tension flotation.

Graywacke is a general term used in the field to designate certain obscurely bedded, in places much altered, greenish rock, which ranges in texture from distinctly conglomeritic to aphanitic. Some of the finer-grained graywackes can with difficulty be distinguished from igneous rocks. The result of field study led to the inference that the graywackes consist largely of igneous material worked over mechanically, but not greatly decomposed before deposition, and the inference is confirmed by microscopic study. Since their deposition, however, they have in places been greatly changed by shearing, brecciation and the development of secondary minerals. The degree of metamorphism necessary to convert a certain rock into graywacke has not been determined or defined.

At the Black Oak mine, on the Mother Lode, Cal. jackhammers have replaced piston machines in shaft-sinking with a reduction of costs, air consumption, etc. The rock is the Soulsbyville granite, a hard, gray granite which has a more than local reputation. Different sections of the shaft were sunk with each type of machine, so that comparative results were obtained. Four men were used on a shift in each case—in the one, on two piston machines, and in the other, each with a jackhammer—and it was found that the daily progress was increased approximately 25 per cent by using the jackhammers. No attempt was made to make a comparison of the air used, but it is known that the four jackhammers used less than the two piston machines.

The Ideal "delay-action" exploder for firing a round of shots, has given good results in the Black Oak shaft. It consists of a detonator, a time fuse-whose length is chosen to suit the position of the hole-and an electric fuse spitter to which is connected two copper wires. The detonator is placed in the cartridge in the usual way, and the copper wires attached to the fuses are connected in series, each end of the series being run to a wooden plug in a shallow hole at one end of the shaft. At these plugs connections are made with the two ends of an electric light wire brought down the shaft for this purpose. The exploder switch is in a locked box on an upper level, the key to the box being in the possesion of the shaft foreman. There are no openings for the wires leading down the shaft, so that in each case the connections must be made through the door, which must be unlocked before the wires can be attached to their binding posts, and similarly the door can not be closed until the wires have been removed. As a further precaution the switch is so arranged that the door can not be closed unless the switch is open. The men prepare the holes and the connections and leave the face leisurely and when they reach the level on which the switch is situated, the foreman opens the door, connects the wires and fires the round by closing the switch. Before he can close the door he must disconnect the wires, so that no current can reach the face while the next round of holes is being prepared.

The world's chief zinc-smelting centers have hitherto been Upper-Silesia and Rheinland-Westphalia in Germany; the valley of the Meuse and the Campine in Belgium and Holland; and Kansas, Oklahoma and Illinois in the United States. The industry is now in process of change, and it is likely that zinc production will in the future be less completely centralized. This is due partly to the development, of the flotation process in Broken Hill, Australia, and partly to changes in the ores smelted and conditions of supply and demand. Zinc-smelting was first introduced into England from China, but British smelters have not been leaders in the art. Zinc smelting was begun in Upper Silesia in 1798 and on the Meuse in 1807, and ever since those districts have been leaders in the art. From an early age smelting there was conducted by educated metallurgists, and in both France and Germany there is a literature of zinc smelting extending back for a century. In the United States, on the other hand, only two works—those at La Salle and Peru in Illinois—have a long history. In the Pittsburg, Kansas, district the industry was carried on for thirty years with entire disvegard of scientific control. Not until 1898 were chemists employed even to assay the ores.

New Publications.

Engineering Geology, by Heinrich Ries, Ph. D., professor of economic geology in Cornell University, and Thomas L. Watson, state geologist of Virginia; 6 by 9, 722 pp. 249 figures in the text and 104 plates comprising 175 figures. Cloth, net $4.00, John Wiley & Sons, Inc. New York.

Orders of Architecture, by A. Benton Greenberg, B. A., 20 loose-leaf problem sheets, 8 by 10 1/2, Paper binding, 50 cents net. John Wiley & Sons, Inc., New York.

Diophantine Analysis, No. 16 of the Mathematical Monograph Series by Robert D. Carmichael, assistant professor of mathematics, in the University of Illinois, 118 pp., 6 by 9, cloth, $1.25 net, John Wiley & Sons Inc., New York.

Wireless Telegraphy by J. Zenneck, professor of experimental physics at the Technische Hochschule, Munich; translated by A. E. Seeling, formerly general manager, the Atlantic Communication Co.; 6 by 9, 428 pp., 461 illustrations, 13 tables, $4.00 McGraw-Hill Book Co., New York.

The Gasoline Automobile by George W. Hobbs and Benjamin G. Eliot, A. guide and text book for those who drive, repair and sell motor cars. 6 by 9, 256 pp., fully illustrated, published in both loose leaf and book form. Price $2.00 net. McGraw-Hill Book Co., New York.

Surveying Manual by William D. Pence and Milo S. Ketcham, fourth edition. Total Issue, 33,000. 388 pages, including 131 pages of tables, 4½ by 7, illustrated, morocco, $2.00 McGraw-Hill Book Co., New York.

Engineering Thermodynamics by James A. Moyer and James P. Calderwood, 211 pages, 6 by 9, 70 figures. Cloth, $2.00 net. John Wiley & Sons, Inc., New York.

Centrifugal Pumps, by R. L. Daugherty, the features of construction, the theory, characteristics, general laws, commercial factors, testing and design, 192 pages, 6 by 9,111 illustrations, $2.00 net, McGraw-Hill Book Co., New York.

Direct Acting Steam Pumps, by Frank F. Nickel, associate in mechanical engineering, Columbia University. 258 pages, 6 by 9,218 illustrations, $3,00, McGraw-Hill Book Co., New York.

A Textbook of Engineering Thermo Dynamics by Chas. E. Lucke and John J. Flather. 688 pages, 6 by 9,189 illustrations, $5.00. McGraw-hill Kook Co., New York.

Heat Engineering by Arthur M. Greene 462 pages, 6 by 9, 198 illustrations, $4.00. McGraw-Hill Book Co., New York.

Engineering Economics, by John Charles Lounsbury Fish, 217 pages, 6 by 9, with tables and charts, $2,00. McGraw-Hill Book Co., New York.

Practical Oil Geology, by Dorsey Hager, 149 pages, flexible binding, pocket size. $2.00 McGraw-Hill Book Co., New York.

Stamp Milling and Cyaniding, by Francis A. Thomson, E. M. 285 pages, 6 by 9,121 illustrations. $3.00. McGraw-Hill Book Co., New York.

Tunneling, by Eugene Lauchli, 238 pages, 6 by 9,197 illustrations. $3.00. McGraw-Hill Book Co., New York.

Dielectric Phenomena in High Voltage Engineering, by A. W. Peek, Jr., consulting engineer, General Electric Co. 265 pages, 6 by 9,190 illustrations. $3.00. McGraw Hill Book Co., New York.

Machine Design, by Albert W. Smith, director of Sibley College, Cornell University, and Guido H. Marx, professor of machine design, Leland Stanford University, 500 pages, 6 by 9; 278 figures, 31 tables. Cloth, $3.00 net John Wiley & Sons, Inc., New York.

Principles of Direct Current Machines, by Alexander S. Langsdorf, M. M. E. 404 pages, 5½ by 8; 313 illustrations. $3.00. McGraw-Hill Book Co., New York.

The Theory of Structures, by Chas. M. Spofford, S. B. Second edition, revised and elarged. 483 pages, 6 by 9; 350 illustration. $4.000. McGraw-Hill Book Co., New York.

The Electric Railway, by A. Morris Buck, M. E., 390 pages, 6 by 9; 193 illustrations. $3.00. McGraw-Hill Book Co., New York.

Mathematical Tables, by Mansfield Merriam, Editor of American Civil Engineers' Pocket Book; 68 pages, 5 by 7¼. Cloth, 50 cents, net. John Wiley & Sons, Inc. New York.

Combined Power and Heating Plants, by Charles L. Hubbard. 408 pages, 6 by 9; 220 illustration. $3.00. McGraw-Hill Book Co., New York.

Third Appendix to the Sixth Edition of Dana's System of Mineralogy, by William E. Ford, assitant professor of mineralogy, Sheffield Scientific School, Yale University, completing the work to 1915,, 87 pages, 6 by 9, Cloth, $1.50 net. John Wiley & Sons, Inc., New York.

Bibliography of Minnesota Mining and Geology. By Winifred Gregory. P. 157. Minnesota School of Mines, Minneapolis, 1915.

Conceptions Regarding the American Devonic. By John M. Clark. P. 19 University of the State of New York, Albany, 1915.

Electro-Plating with Cobalt. By Herbert T. Kalmus, C. H. Harper, and W. L. Savell. No. 334. P. 69. Charts. Department of Mines, Ottawa, Canada, 1915. Results of researches on cobalt and cobalt alloys conducted at Queen's University, Kingston, Ontario, for the Mines Branch of the Department of Mines.

Report of the Sludge Abatement Board for 1914. P. 16, and 17 plates. Government Printer, Melbourne, Victoria, Australia, 1915.

Personals.

H. A. Guess is on a trip to Chile.

Joseph T. Terry Jr. has been conducting flotation tests at the Magma mine, Arizona.

R. M. Raymond is in London, Eng. He expects to return to New York during the present month.

J. V. N. Dorr is in San Francisco.

Roscoe F. Allen has returned to Montana from the Rosario mine in Honduras.

Milton Flynn has returned to New York from Venezuela.

G. A. Denny, recently in Mexico, has gone to the Transvaal, South Africa.

H. C. Enos has returned from Central America and is in Utah.

George B. Holderer, recently in South America, is general manager of the Furlough Development Co., which is opening a copper property in Wickenburg, Arizona.

Arthur Nahl, manager of the Progreso mine, at Triunfo, Lower, California, has returned to Oakland, Cal.

Casey Stites, assistant secretary of the Cananea Con. Copper Co., Sonora, has established himself permanently in Bisbee, Arizona.

A. B. Calhoun, representative of the Mines Company of America, was recently recalled from Chihuahua and is now in Kingman, Arizona.

E. V. Neelands has left for Georgetown, British Guiana, where he will be general manager and director of the company operating the Peters property.

Kirby Thomas has returned to New York from the Southwest.

C. A. Hamilton of the San Juan de Taviche mine has returned to Oaxaca.

W. Benham has come back to Mexico after a few months' sojourn in the States.

Blamey Stevens is in Mexico City from Temascaltepec, Mex.

J. M. Williams of the San Pedro mines at San Luis Potosi expects to leave shortly for the U. S. Lee Carnahan will take his place.

L. A. Fletcher and G. T. Noble are at Hurley, N. M. with the Chino Copper Co. Noble is a member of the engineering staff, while Fletcher is engaged in flotation, which process, he says, will presently proceed to simplify treatment in Mexico.

Fred V. Burns, formerly with the Guanajuato Consolidated Mining and Milling Co., is in charge of the Tampico office of Camphuis & Rives, commercial custom house brokers.

J. W. Malcolmson is at Douglas, Arizona.

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ASK FOR CATALOGUE.

R. T. Mishler, metallurgist to the El Tigre, in Sonora, is in San Francicso.

Alfred Quimby, who is operating a gold mine in Guatemala, is visiting New York.

E. M. Hamilton, F. A. Beauchamp and S. E. Woodworth have opened an office as metallurgical engineers with testing laboratory at 419 the Embarcadero, San Francisco, Cal.

L. V. Dorrien of the Santa Gertrudis Co. at Pachuca has been on a visit to Mexico City.

Cooper Shapley is with the Buckhorn Mines Co., Buckhorn, Nevada.

T. Skewes Saunders, formerly assistant general manager of Las Dos Estrellas, El Oro, Mex., has been appointed general manager, succeeding Andre P. Griffiths.

Several members of the staff of El Oro Mining & Railway Co. are at the front with the British forces. Two among them, G. A. Syme and O. D. Filley, both lieutenants ,have won the military cross. Lieut. Filley is in the Royal Flying Corps and won his cross as the result of an encounter with an enemy aeroplane under exceptional circumstances.

W. E. Simpson has left Mexico and is now in Scotland.

E. David Pope is with the staff of the Société des Mines de Cuivre de Catemou, Chile, and is designing a new concentrating plant at the Soldado mine.

Rolf Marstrander is in northern Uruguay examining possible coal and oil fields for the Instituto de Geologia y Perforaciones.

J. V. Lake has left the Babilonia mine, Nicaragua, for a visit to Australia.

Andre P. Griffths, late manager of the Dos Estrellas mine at El Oro has returned to England.

A. E. Drucker has left La Salada mine, Colombia, having completed the new cyanide plant for the Frontino & Bolivia Mining Co.

E. J. Q. Dickson has left Mexico and is in England.

O. Gore Adams engaged in tin mining in Bolivia is on a visit to New Zealand.

C. A. Buck of the Bethlehem Steel Co. has returned to the U. S. after several months' stay at the company's Tofo iron mines, Chile.

Camphuis-Rives Co., custom brokers at El Paso and Tampico, have opened an office at Vera Cruz.

D. S. Calland of the Real del Monte Company. Pachuca, has returned from Laredo where he arranged for the shipment of supplies.

Dr. J. A. Udden, geologist of the Bureau of Economic Geology, University of Texas, Austin, has been appointed Director of the Bureau, the former director, Dr. Wm. B. Phillips, having resigned to become president of the Colorado School of Mines.

Harry Benton is contracting at the Cabrera mine for the Real del Monte Co.

H. A. Fowler, manager of the Chontalpan mine, and Carl Hanssen, mine superintendent, are temporarily in Mexico City, the activity of roving bands having rendered operations at the property impossible.

Frank Booth is in Mexico City from Sultepec.

Andrew Ennis has recently bought a ranch near Silao.

Joe Kescel is in New York writing for the magazines.

C. E. Rhodes has gone to El Oro.

J. N. Branch, now with the Pierce Oil corporation has returned from a trip to the North.

A. C. Savage has, in addition to getting married, recently opened an engineering office in El Paso, the firm name being Sištermans, Mecuca & Savage.

J. P. Warr, of Pachuca, is in Mexico City.

Alfredo Lockhart has gone to Pachuca on a business trip.

Sydney Ludlow is in Mexico City having returned from England with his family.

T. Decker is in the city from Chihuahua.

Geo. Bridger, assistant superintendent Hacienda Guerrero, and W. Blamey, zinc-room man of the same mill, are ill in Mexico City.

F. K. Boyd has returned to Mexico.

J. M .Platt, of Zacualpam, is in the U. S. and expects to return during the present month.

Gustavo Traeger is expected to return from the U. S. about the first of the yeai.

Arthur Bittner, manager of the Monte Carlo mine, Zacualpam, is in Mexico City.

Trade Notes.

The Anaconda Copper Mining Co. has ordered three additional 10-ft. by 48-in. Hardinge mills.

Nineteen parcels of land (an entire city block) have just been acquired by The Cleveland Galvanizing Works Co., Cleveland, Ohio, adjacent to its present location which is in the heart of the city.

The American Cyanamid Co. now has its general offices at No. 200 Fifth Avenue, New York. The Nashville and Buffalo offices were discontinued on Oct. 1. A southern officers is maintained at 604 Walton Building, Atlanta, Ga.

The Salt Lake office of the Mine and Smelter Supply Co. has received orders for No. 64½ Marcy mills for the following companies: Silver King Coalition Mines Co., Park City, Utah, 2; Duquesne Mining Co., Duquesne, Ariz., 1; Red Banks Mining Co., H. C. Callahan, Bagby, Calif. 1.

The Standard Forgings Co., Indiana Harbor, Ind., is about to erect three buildings as an addition to its works, at a cost of $100,000. The buildings will be of steel construction.

In connection with an industrial exposition at Denver the Colorado School

of Mines has been showing a Dings 2-magnet separator as a part of its experimental plant. An illustration was given of how many Colorado ores containin minerals of different magnetic intensities can be separated by mean of this device. A gold medal was awarded to the school for the testing plant exhibit.

Road Construction and Maintenance. Published by the E. I. du Pont de Nemours Powder Co., Wilmington, Delaware. P. 120 Illustrated. In these days of heavy traffic proper road construction is highly important, and enormous sums of money are being spent in such work throughout the country. This interesting book discusses location of road, clearing the right-of-way, drainage, construction, and maintenance. Details of blasting trees and rocks are especially practical and valuable, as they should be, coming from such a source. The work has been carefully prepared, and is of use to miners, road engineeers, and farmers.

J. D. Mooney has been appointed sales manager of the commercial department of the Hyatt Roller Bearing Company, Newark, N. J. For some years he has been in charge of belting sales for the B. F. Goodrich Company, Akron, Ohio.

As a substitute for hand or pole shifting of belts from one step of a cone pulley to another, the Alexander & Cox Co., 2358 Ogden Avenue, Chicago, has placed a new belt shifting device on the market. The vertical rod of the device has a telescopic automatic adjustment to accommodate it to the height of the ceiling, thus doing away with the necessity for accurate measurements when fitting to the cone pulleys of a given machine. A clamping arrangement allows the shifter loop and the vertical tube to be held in any position.

During the past 2 weeks the Snyder Electric Furnace Co., Chicago, started up three basic furnaces at the plants of the Gerlinger Steel Casting Co., Milwaukee, Halcomb Steel Co., Syracuse, and Dayton Steel Foundry, Dayton. The Gerlinger furnace is the same type and size as those which were started up during September in the plants of the Niagara Electric Steel Corporation, North Tonawanda, and S. Fair & Son, Inc., Saginaw. It has a 24-hour capacity of 6 tons. The Halcomb furnace has a 24-hour capacity of 30 tons and the Dayton furnace a capacity of 10 tons. Metal for the second heat of the Gerlinger furnace showed a tensile strength of 72,000 lbs. unannealed and 120,000 lbs. annealed with an elongation of 20 per cent in 2 ins. The carbon content was 0.45 per cent. The Halcomb furnace poured good tool steel ingots on the very first heat and is operating satisfactorily as designed and guaranted.

A flat plate valve for air compressors, which differs in design from those now on the market, has been developed by the Chicago Pneumatic Tool Co., Fisher building, Chicago. The special feature of the valve is the provision of an automatic arrangement for varying the size of the opening according to the speed of operation. The valve consists of three independent concentric steel plates, one for each annular port. These plates are governed by their own springs only and the opening or closing of each valve is independent of the other. These valves are used both on the inlet and discharge sides of the compressor and with a view to preventing the reversal of the valves, the inlet valve is of lighter construction than the discharge. The variation in the amount of the valve opening is governed by the speed of operation. When the compressor runs at a slow speed only one plate of the valve opens, while as the rate of operation increases two plates open and when the full speed is obtained all of the plates open.

The Colorado Fuel & Iron Co. has issued the first number of an industrial bulletin which will be published monthly hereafter for the purpose of co-ordinating harmonizing and furthering the social and industrial betterment work of the company, and also for purposes of informing the company's employes of the personnel and proceedings of conferences, boards and committees in which they are interested. It also is expected that the bulletin will form a record of events pertaining to social and industrial activity.

The Allis-Chalmers Mfg. Co., Milwaukee, Wis., added 360 men to its payroll

Monthly Average Prices of Metals.

SILVER

MONTH	New York			London		
	1913	1814	1915	1813	1914	1915
January	62.938	57.572	48.856	28.983	28.553	22.731
February	61.642	67.506	48.477	28.367	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	69.490	58.519	50 250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	58.890	56.471	49.034	27.188	26.948	23.267
July	58.721	54.878	47.518	27.074	25.218	22.587
August	58.283	54.344	47.183	27.335	25.978	22.780
September	80.640	53 280	48.880	27.886	24.280	23.591
October	80.783	50.854	49.385	28.083	23.198	23.825
November	58.995	48.082	51.714	27.283	22.703	25.094
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	....	27.576	25.314	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

LEAD

MONTH	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	18.851	21.883
Apri	3.810	4.221	3.888	4.142	18.225	21.094
May	3.800	4.274	3.808	4.182	18.503	20.347
June	3.900	5.832	3.810	5.836	18.411	25.170
July	3.881	5 859	3 738	5.531	19.051	24.811
August	3.875	4.856	3.715	4.520	.....	21.846
September	3.828	4.610	3.858	4.490	.....	23.151
October	3.528	4.100	3.384	4.499	.....	23.994
November	3.883	5.155	3.565	5.078	18.500	26.278
December	3.800	.....	3.682	.....	19.097	.....
Year	3.862	.....	3.737	.....	.....	.....

COPPER

MONTH	New York Electrolitic		London			
			Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	66.719
February	14.491	14.394	65.269	63.494	70.188	.....
March	14.131	14.787	64.276	66.162	69.170	.....
April	14.211	16.811	64.747	75.096	69.313	.....
May	13.996	18.506	63.182	77.600	67.786	95.333
June	13.603	19.477	61,336	82.574	66.274	91.409
July	13.223	18.786	60.540	78.011	64.055	82.333
August	.....	16.841	.....	88.873	.....	.....
September	.....	17.502	.....	88.915	.....	.....
October	.....	17.886	.....	72.801	.....	88.000
November	11.739	18.827	53.227	72.744	.....	.....
December	12.801	.....	56.841	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....

SPELTER

MONTH	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.282	6.386	5.112	6.211	21.533	30.844
February	6.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	68.100
June	5.000	21.208	4.850	21.038	21.345	100.614
July	4.820	19.026	4.770	18.856	21.568	97.250
August	5.568	12.781	5.418	12.611	.....	87.786
September	5.380	13.440	5.230	13.270	.....	67 841
October	4.908	12.800	4.750	72.596	.....	68.536
November	5.112	15.962	4.882	15.792	25.018	88.409
December	5.582	.....	5.430	.....	27.368	.....
Year	5.213	.....	5.061	.....	.....	.....

New York and St. Louis quotations, cents per pouud London, pounds sterling per long ton. *Not reported. London Exchange closed.

TIN

Month	New York		London	
	1914	1915	1914	1815
January	37.779	34.260	171.905	166.550
February	39.830	37.415	181.566	176.925
March	38.038	48.426	173.819	180.141
April	36.154	47.884	183 963	166.225
May	33.360	38.790	150.702	162.675
June	30 677	40.288	138.321	167.636
July	31.707	37.423	142.617	167.080
August	.....	34.389	.....	161.440
September	32.675	33.125	.....	152.825
October	30.284	33.080	.....	151.554
November	33.304	39.224	139.391	187.670
December	33.601	.....	147.102	.....
Av. year	34.301	.....	....	.....

Legal Value of Pure Silver.

The monthly price of pure silver which will serve as the basis for calculating the stamp tax for the month indicated, as fixed by the Secretary of the Treasury in conformity with the law of March 26, 1905.

MONTH	1914	MONTH	
January	$52.54	July	
February	51.25	August	
March	52.67	September	
April	58.43	October	
May		November	
June		December	

AMERICAN SOCIETY OF MEXICO.

The Society of the American Colony of Mexico City has been reorganized on broader lines, under the name of "The American Society of Mexico."

At a mass meeting recently held in the City of Mexico a new Board of Directors was elected, together with the following named officers: President: R. M. Raymond; Vice President, Dr. Sidney Ulfelder; Secretary, J. D. Helm; and Treasurer S. S. Conger.

At a later meeting the Society adopted a new Constitution and By Laws, providing for permanent organization. This is broad in scope, to cover present and future needs.

The object of the Society as stated, is to promote the welfare of the American residents of the Republic of Mexico. Among other powers the Society is authorized to take cognizance of and act upon all subjects of general interest of its members; to promote and establish mutual cooperative relations; to cooperate with and assist other American institutions of Mexico; to provide, when expedient, a home or house for the accommodation of its members; and to acquire property when desirable for the uses of the Society.

All properly recommended nationals of the United States of America, either men or women residents of the Republic of Mexico, may become members of the Society by signing cards of registration.

The principal office of the Society is to be in the City of Mexico, but branch offices may be established elsewhere.

Heretofore the membership has been limited to men, but in the reorganization the women are invited to join. The present membership of about 1,300 will at once be largely increased.

A cordial invitation is extended to all Americans, men and women, throughout the Republic to identify themselves with this movement for mutual benefit. Naturally the Society will be non-political and non-sectarian. It is also entirely democratic and requires of applicants nothing more than a recommendation as to good character.

It is hoped that Americans of all occupations throughout the Republic will recognize the importance of such an organization and will identify themselves with it. If they do real benefits can be secured for all concerned.

There is need for a strong Society and better opportunities for acquaintance than have heretofere existed among the Americans so widely scattered over this great and undeveloped country. It is important that more and reliable information be had of the Americans living in Mexico, and that a common channel of communication be provided for various purposes. This will give an opportunity for united expression of sentiment and united action in matters relating to the common good. It will make possible a registration of American residents that has not existed heretofore.

When the plans are fully developed in the course of time the Society will be able to provide a Club or meeting place for Americans from all parts of the Republic when they visit the capital; meantime it can be made useful as a source of information to non-resident members.

All who feel an interest are invited to correspond with.

J. D. HELM, Secretary.

408 LA MUTUA, MEXICO, D. F.

in October and is now employing approximately 5200 workmen. The operations are on the basis of 80 per cent. At the main offices in West Allis, it is stated that business is growing steadily in nearly every department. Sales of the company during July, August and September, according to a statement just just filed, were $3,062,371. Sales for the preceding quarter totaled $2,816,181. Unfilled orders on hand amount to $8,000,815. The figures for October, November and December are expected to show another increase.

The Bucyrus Co. has opened an office at 900 Hibernian building, Los Angeles, Cal., in charge of G. H. Hutchinson.

W. R. Thurston has been appointed manager of the Mine & Smelter Supply Co.'s Salt Lake branch. F.E. Marcy, former manager, will still be associated with the company and devote his efforts to selling and developping the Marcy ball mill.

The American Car and Ship Hardware Manufacturing Co., general offices and works, New Castle, Penn., is making large addition to its present plant.

The Bayard Chemical Co. is equipping a plant at Edgar Station, Woodbridge, N. J., for the manufacture of phenol, salicylic acid and a general line of pharmaceutical chemicals. Post office address is Woodbridge, N. J.

E. E. White, agent of the Mass patent drill hole compass, announces that 12 of these compasses have been rented to prominent exploring companies and drill contractors in the United States, Canada and Russia and are proving very successful.

The Homestead Valve Manufacturing Co., Homestead, Penn., is manufacturing an angle-type blow off valve, to be used in connection with its plug cock, where a double blow-off arrangement is desired on steam boiler blow-off lines. The body of the "Hovalco" valve is of semi-steel, and the seat and disk are made of Monel metal. The valve is designed for 250-lb. pressure in 1½ to 3-in. sizes and with screwed and flanged body.

Charles Hardy has established a business at 50 Church street, New York, as a broker in antimony and antimony ore, tungsten metal and tungsten ore, copper ore, and other minerals. Mr. Hardy was engaged in this line in London for 12 years. In the course of his business career he has visited 40 countries.

During the week of November 1 to 6, the Oliver Continuous Filter Co., of San Francisco, has received orders for filters from the following mills: Chichagoff Mining Co., Alaska; Teck-Hughes Gold Mines Co., Swastika, Ontario, Canada; Duquesne Mining & Reduction Co., Duquesne, Arizona; Walker Mining Co., Portola, California; Calaveras Copper Co., Copperopolis, California; and the Federal Mining & Smelting Co., Wallace, Idaho.

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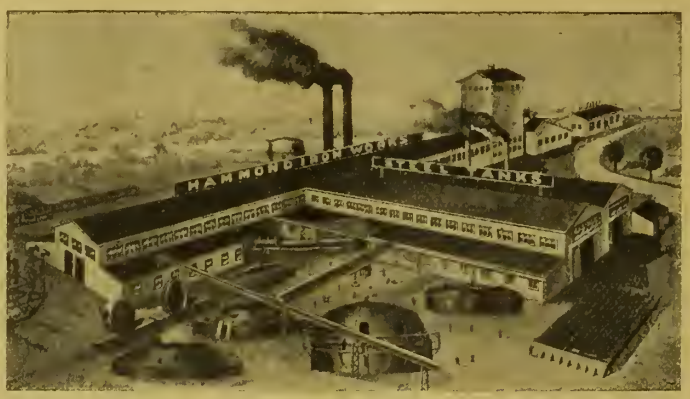

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El Costo del Canal de Panamá.

De una crónica publicada en la "Revista de la Sociedad Cubana de Ingenieros" tomamos los siguientes datos sobre el costo del Canal de Panamá:

Las noticias oficiales dadas a la publicidad sobre el costo del Canal han formado en el público la opinión de que el costo ascendería a unos $400.000.000,00, cantidad ésta muy exagerada, pues según el "Canal Record" sólo se han gastado hasta Marzo 31 de 1914, por el Departamento de Ingeniería y Construcción $204.087,000.

El gasto hecho hasta esa fecha por todos conceptos ha sido $322.659.000, siendo los capítulos más importantes, aparte de los de ingeniería y construcción, los siguientes: administración civil, $7.000.000; sanidad, $17.000.000; fortificaciones, $5.000.000; gastos generales, $90.000.000. En este último capítulo están incluídos $40.000.000 pagados al Gobierno francés y $10.000.000 a la República de Panamá. También están incluídos los gastos inherentes a la reconstrucción del Ferrocarril a Panamá, construcción y reparación de edificios en Colón y Panamá. Es cierto que todos estos gastos han sido necesarios, pero debe hacerse público que el costo del Canal propiamente dicho, incluyendo la maquinaria necesaria para su funcionamiento, fué solo, hasta aquella fecha, de.... $240.000.000.

Cálculo de Escaleras.

Constituye tema de continuas discusiones el problema de la determinación teórica de las dimensiones que deben tener las gradas de las escaleras, para el caso tan común, de disponer de espacios fijos, en sus proyecciones horizontal y vertical. Debido a los muchos tanteos que su cálculo requiere, algunos prácticos concluyen por adoptar dimensiones arbitrarias que dan por resultado la morosidad de parte de los operarios, y el defecto tan chocante de escaleras con diferentes contragradas.

Estudiando con alguna detención este asunto, creo haber llegado sino a un resultado exacto, por los menos a orientar el problema hacia una aproximación bastante aceptable y práctica, por el pequeño empleo de fórmulas y su fácil comprensión.

El Sr. Ingeniero Don Teodoro Elmore, cuya larga experiencia en materia de construcción es manifiesta, recomienda en su libro "Lecciones de Arquitectura," como fórmula conveniente, para el cálculo de escaleras, la siguiente de Rondolet; $2d+a=0.65$, en la que a representa el ancho de la grada (marcha) y d la altura de la misma (contramarcha). Ahora bien, para usar esta fórmula es necesario dar un valor arbitrario a una de las incógnitas, generalmente a d, con lo que se obtene un valor para a; en seguida se divide la altura total conocida por d, y da el número de escalones por a y el resultado será el espacio horizontal que ocupará la escalera.

Como se ve, en este caso, la proyección horizontal se obtiene por el cálculo, pero si estuviera determinada de antemano, hubiera sido necesario variar el valor arbitrario que se escogió para d si el resultado no hubiera coincidido con el dato. He aquí, pues, el origen de los muchos tanteos para conseguir dicha coincidencia, pero esto se puede evitar como vamos a verlo.

Sean: a= marcha; d= contra marcha; n=n° de escalones.

A=espacio horizontal. D=altura por salvar.

Las tres primeras letras son las incógnitas y las dos últimas los datos. El artificio consistirá en procurar eliminar dos incógnitas, para lo que tengo en cuenta que:

$$a = \frac{A}{n} \qquad d = \frac{D}{n\ 1}$$

Despejo en ambas igualdades:

$$n = \frac{A}{a} \qquad n = \frac{D}{d} - 1 \qquad (1)$$

Igualo para eliminar n y obtengo:

$$\frac{A}{a} = \frac{D}{d} - 1$$

Ecuación con dos incógnitos que combinada con la de Rondolet da el sistema determinado siguiente:

$$\frac{A}{a} = \frac{D}{d} - 1$$
$$2d + a = 065$$

Resolviéndolo quedará eliminada la segunda incógnita a y resulta la ecuación de segundo grado de la forma.

$2d^2-(A + 2d + 065)d+ 065 D=O$

en la que se reemplazarán los valores de a y d para hallar d que servirá para buscar por la fórmula de Rondolet el valor de a. Para obtener bastará reemplazar los valores ya obtenidos en cualquiera de las igualdades (1), con lo que quedará resuelto el problema.

Este método se empleará siempre que se quiera la mayor exactitud, como por ejemplo cuando se trata de escalera de mármol en edificios importantes; pero si se desea llegar a un resultado bastante próximo al anterior, sin afectar notablemente dicha exactitud y facilitando grandemente los cálculos, se procederá haciendo la siguiente consideración: supongamos que el piso superior constituya la última marcha, entonces el número de contramarchas no será mayor en una unidad, como en el caso anterior sino el mismo. Esta consideración nos induce a aumentar la longitud de la proyección horizontal en una cantidad proporcional al ancho de un escalón, (0.25 mtrs. como término medio estimo conveniente) pues el piso superior decimos que es la última marcha de la escalera, lo que nos dará las nuevas igualdades siguientes:

$$n = \frac{A}{a} \qquad n = \frac{D}{d}$$

que igualando con el objeto ya indicado:

$$\frac{A}{a} = \frac{D}{d}$$

y combinado con la de Rondelet, tenemos también un sistema:

$$\begin{cases} A\,d = D\,a \\ 2d + a = 0.65 \end{cases}$$

Resolviéndolo da: $A\,d=0.65\ D-2\ D\ d$ ecuación de primer grado en la que despejando la incógnita:

$$d = \frac{0.65\ D}{A+2d}$$ puede expresarse así:

El valor de la contra grada cuando se dan las dos proyecciones de una escalera, es igual al cuociente que resulta de dividir los 0.65 de la proyección vertical,

Escrito por el Ing. Ricardo Dibarbu en Informaciones y Memorias.

por la proyección horizontal, aumentada del doble de aquella.

Ejemplo.—Se desea construir una escalera a un segundo piso que se encuentra a 4.50 m. de altura, y en un espacio de 7 metros dc longitud. Aplicando la primera fórmula, tendríamos:

$2\ d^2—(7+2\times4,\ 5+0,65)\ d+0,65\times4,\ 5=0$

Reduciendo: $2\ d^2—16,65\ d+\ 2,925=0$

Resolviendo: $d = \frac{16,65—15,93}{4}$

Existen dos soluciones, adoptaré por consiguiente la que concuerda con la índole del problema, tal es la diferencia:

$$d = \frac{16,65—15,93}{4} = 0'18$$

Con este valor busco a; $a=0.65—2\times 0.18=029$

y el número de esealones será $\frac{4.5}{0,18}—1 = 24$ o bien 25 contra marchas.

Procediendo ahora con la fórmula práctica, y considerando en lugar de 7 metros de proyección 7,25 metros se tene:

$$d = \frac{0.65 \times 45}{7,25 + 9} = 0.18$$

Por consiguiente procediendo como antes

$a = 0.29$ y n $\frac{4.5}{18}$ 25 escalones

Observaré lo siguiente: que si divido $A/a=7,25/0,29=25$ escalones también; pero no siempre al efectuar estas divisiones los resultados son exactos, sino que queda un resto de centímetros; entonces se le reduce a milímetros y se reparten proporcionalmente entre el número resultante de escalones, con lo que aumenta su dimensión respectiva.

Como vemos, pues, se ha obtetnido el mismo resultado en ambos caso,s luego se preferirá el segundo método de cálculo, que además de no ser complicado, evita los errores que con mayor número de operaciones, se pudiera cometer.

Quedará al criterio del ingeniero señalar la necesidad de adoptar un descanso, cuando la dimensión a resulte grande y de pequeña. En ese caso se calculan los tramos separademente.

Lima, Junio de 1915.

*Nuevos Procedimientos para la Obtención de Gasolina de residuos de la Destilación del Petróleo.**

En los últimos años, la industria de la destilación y refinado del petróleo ha experimentado grandes progresos a consecuencia de la constante demanda de sus productos derivados y en particular de los conocidos con el nombre genérico de naftas o gasolinas o sean los productos ligeros, antes considerados como de escaso valor.

Hasta hace poco, los productos del petrólco más acceptados en los mercados eran los kerosenes, los aceites lubricantes y las parafinas, productos cuya demanda variaba con los países y las cotizaciones respectivas, de modo que ya era ventajoso tratar petróleos ricos en aceites lubricantes porque en esos momentos eran esos productos los que se vendían con más beneficio, ya otras veces al contrario había interés de producir petróleo lampante o parafinas.

Etsas consideraciones explican el hecho extraño, constatado en los Estados Unidos, de que en ciertas ocasiones el kerosene ha valido más barato que el petróleo bruto del cual se le extraía. En ese caso el kerosene que frecuentemenconstituye el principal producto de la destilación no venía a ser sino un subproducto tomando los aceites pesados el primer rango.

Pero desde que la marcha de los motores de explosión fué práctica e industrial y además el automovilismo terrestre y marítimo entró en el rol de las aplicaciones usuales la gasolinas vinieron a ser productos muy solicitados y pronto se vió que toda su producción no era suficiente para satisfacer el consumo cada vez más creciente. Así, mientras mientras que en el año de 1898, en los Estados Unidos la producción de la nafta fué de 17.258.000 galones con un precio de 6 centavos oro por galón, la producción en 1912 fué de 186.000.000 de galones con un precio medio de 11 centavos oro el galón y en 1913 fué de.... 280.000.000 de galones y el precio en 1914 (antes de la guerra) llegó a 21 centavos oro el galón.

Uu aumento extraordinario de naftas se ha obtenido también en los demás países petroleros, habiéndose llegado a pagar en 1913 por petróleo crudos de Perehinsko y Rypne (Austria) ricos en bencina hasta £ 5 por tonelada y más o menos igual precio por petróleos crudos de Bana (Rumania) y de Yza (Hungría).

La demanda de las naftas y el aumento de sus precios ha hecho que se busque no solo de trata rde preferencia los petróleo ricos en esencia sino que se trate de obtener de todos los petróleo mejores rendimientos e nsu destilación, sea por perfeccionamientos introducidos ésta, sea por la adopción de procedimientos comvletamente nuevos con la ingerencia de nuevos elementos de acción tales como la sobrepresión y los agentes químicos. En la demanda, se ha llegado hasta utilizar para el caso petróleo, con con los que se ha logrado generar naftas que en buena provorción se consumen hoy e nlos mercados.

Por el interés que tales progresos en el mejor aprovechamiento de los petróleos naturales pueden traer al país productor de esa sustancia, daré a conocer el estado actual de los últimos perfeccionamientos introducidos para generar las gasolinas.

El petróleo, como se sabe, en síntesis es compuesto esencialmente de hidrógeno y de carbono unidos en la forma de hidro-carburos de composición variable y constitución compleja, llevando frecuentemente pequeñas proporciones de oxígeno, azufre y ázoe.

Los diferentes hidrocarburos con aspecto y composición distintos, pero todos ellos en general pueden considerarse comprendidos dentro de los dos tipos.

a) Petróleos asfálticos, aquéllos que rinden a lenta destilación un residuo obscuro asfáltico, el cual es inmediatamente atacado por ácidos y disuelto en disolventes usuales.

b) Petróleos parafinosos, aquellos que rinden en reducción a baja temperatura una apreciable proporción de hidrocarburos sólidos, ligeramente coloreados sobre todo de la serie de las parafinas, los que no son atacados fácilmente por ácidos y disolventes normales.

Tanto los petróleos crudos de carácter asfáltico como parafinosos son compuestos de una variedad de hidrocarburos de diversas densidades y de diferentes puntos de hervir, de modo que cuando se les somete a la calor, los varios constituyentes hidrocarburados del petróleo tienden a separarse tanto como se aproxima la temperatura de su punto de hervir.

La determinación de los compuestos hidrocarburados constituyentes del petróleo y su separación es una tarea difícil, notablemente complicada por;

a) La existencia de los que son conocidos como isómeros, es decir, de hidrocarburos de la misma composición química cuantitativa, pero que contienen diferentes cualidades con motivo de la diferente agrupación o disposición de los átomos en las moléculas.

b) El acontecimiento del fenómeno llamado craking por el que durantet el proceso de la destilación los hidrocarburos de una composición son reducidos a los más bajos miembros de la misma serie o aun convertidos en otras series de hidrocarburos.

"Reconocemos, dice el conocido químico Dr. David T. Day, que la separación de esta gran mixtura en aceites todos simples está lejos de su posibilidad, pues mientras se separan estos constituyentes muchos de ellos se desdoblan todavía en otros nuevos aceites por los agentes que se usan en la separación (calor, reactivos químicos, etc.)"

"Mientras tanto, es un hecho que se pueden agrupar los aceites componentes en pocas series homólogas y dentro de cada serie, cada aceite difiere del próximo miembro por un determinado monto de hidrógeno y carbono y con distinto punto de hervir lo que hace posible ciertos métodos de preparación. Hay simialr diferencia cn vicosidad, gravedad específica, etc., cuyas propiedades son también valiosas para ayudar la separación."

Dichas series las constituyen:

Los hidrocarburos saturados Cn H_{2n+2}

Los hidruros aromáticos Cn H_{2n}.

Los carburos etilénicos Cn H_{2n} y acetilénicos Cn H_{2n-2}

Los carburos aromáticos Cn H_{2n-6}

Dentro de cada serie existen muchos miembros que difieren notablemente unos

de otros. Así en la serie de hidrocarburos saturados C H^{2n+2}, homóloga del gas de los pantanos, se tiene que la parafina es tano C H^4 que es gaseoso, que se presenta en gran cantidad disuelto en el petróleo y que forma el principal constituyente del gas natural, es el más bajo miembro de la serie de las parafinas. El metano es un hidrocarburo saturado que contiene en peso el máximo porcentaje de H (75 por 100) y el mínimo porcentaje de C (25 por 100) y los demás miembros de la misma serie contienen un mayor porcentaje de C y más bajo porcentaje de H.

Bajo el punto de vista comercial los petróleos se clasifican según la proporción de esencias o naftas y de petróleo iluminante o kerosenes que son susceptibles de dar por destilación, conviniéndose en considerar, según el método adoptado de Engler, como bencinas aquellos productos que destilan hasta 150° centígrados o sea 352° Fahr, y como petróleos iluminantes aquellos que destilan entre 150° y 300 grados centígrados (350° 572° Fahr).

Como se sabe, cuando se somete el petróleo crudo a la acción del calor regulándolo en modo de aumentarlo progresivamente, los compuestos que lo constituyen se desprenden sucesivamente por orden de volatilidad al mismo tiempo que la masa se modfica bajo la influencia de las acciones pirogenéticas.

En este fenómeno, que ejecutado en escala comercial constituye la destilación y refinación del petróleo, se ha establecido; que no hay duda que llegado cierto momento de la operación, algunos carburos sufren una descomposición más o meno scompleta y generan a la vez hidrocarburos más simples y de términos mál altos; que la destilación parece tiene por efecto dar a los hidrocarburos que constituyen el petróleo, o por lo menos a quellos que son susceptibles de descomposición durante la destilación, más estabilidad.

De ahí, que petróleos de carácter general similar no consistan necesariamente en una mixtura de los mismos hidroarburos, así, dos petróleos rindiendo aproximadamente la misma proporción de buena clase de bencina, kerosene y aceites lubricantes pueden estar compuestos de una mixtura de hidrocarburos completamente diferentes, pertenecientes a series químicas totalmente distintas. Es por esto que en la práctica de la destilación no sólo hay que tener en cuenta las propiedades físicas, sino también las propiedades químicas de los hidrocarburos que se tratan.

Tal como en la actualidad se encuentra el arte de la destilación, en el curso de ella se obtienen los siguientes grupos de productos:

a) nafta cruda.

b) petróleo de quemar, (gas oil).

c) un destilado mezclado de hidrocarburos con punto de bullición como nafta y con un punto de ebullición a más alta temperatura y con viscosidades variadas.

d) destinlados espesos de parafinas.

e) zupias espesas de parafinas.

f) cera cruda de alambique o zupias de cera.

Según el desarrollo histórico, un primer progreso en la manufactura de los productos livianos tales como las gasolinas y los kerosenes, para obtener su pureza, fué el tratar los productos ligeros destilados con SO^3; mediante la acción del ácido frío y suficientemente fuertet puede destruirse y así separarse todo los grupos, con excepción de los que se llaman hidrocarburos parafinosos y si se usa el calor, fácilmente ataca también todos los hidrocarburos parafinosos arrastrados durantet la destilación preliminar. Esta operación es la que constuye el refinado.

Otro progreso a fin de aumentar el rendimiento en productos livianos especialmente en petróleos lampantes, ha sido la generalización del uso en todas las refinarías modernas del craking durante la destilación operación que como su nombre lo indica no es un simple rompimiento sino una verdadera disociación que se produce cuando ciertos hidrocarburos pesados están sometidos a una temperatura superior a su punto de ebullición. En este caso, los destilados siendo recolectados en la parte superior del alambique y dejado su domo expuesto a la atmósfera, parte de los productos de la destilación son condensados por ese medio y origina su caída dentro del fluido caliente. El resultado de tal acción es la reducción de hidrocarburos en productos de baja densidad y bajo punto de hervir, acompañada por la formación de una cierta cantidad de gas permanente.

La exacta acción del craking parece poco conocida y generalmente es entendido que los petróleos craked son inferiores a los uncracked y por ello requieren más rfinado.

Un reciente progreso en el desarrollo de la refineríía del petróleo ha sido la la aplicación industrial del uso de la sobre-presión durante la destilación con lo que se ha logrado fabricar muy económicamente gasolinas del residuo de la destilación de los petróleos o sea de los aceites densos combustibles, gas oil, etc., mediante la reducción de ellos bajo presión superatmosférica.

El principio en que se funda este procedimiento es teóricamente conocido desde mucho tiempo. Así Riche y Halphen en su obra "Le pétrole" pág. 149 dicen: "Las interesantes investigaciones de S. Hana Hayes han mostrado que los productos ligeros del petróleo pueden ser transformados en aceites pesados cuando se les calentaba bajo presión en presencia del vapor de agua."

"Sometido a la destilación bajo presión la parafina, los señores Thorpe y Young, han hecho gran luz sobre la naturaleza de las reacciones pirogenéticas debidas al cracking; ellos han establecido que los carburos pesados de la serie grasa se descomponían no sólo en términos más simples sino en hidrocarburos pertenecientes a otra serie. La mezcla final es sobre todo compuesta de olefinas y de una pequeña cantidad de carburos de la serie de las parafinas."

"Los fenómenos de descomposición son conforme a la teoría de disociación de los hidrocarburos formulada por M. Berthelot. Ellos generan compuestos más estables, generalmente menos ricos en hidrógeno que los hidrocarburos de los que provienen."

El Dr. David T. D ay, en 1913 en su conferencia en Londres, decía: "Ciertos petróleos mexicanos contienen naturalmente solo 2 por 100 de gasolina, más por lento calentamiento aquellos petróleos se quiebran y pueden rendir 7 a 8 de gasolina. Pero los llamados "cracked" son mal olientes y dificultan la refinacóin. Hace varios años he encontrado que si esos petróleos son destilados bajo presión, el rendimiento de gasolina es aun aumentado más y que el mal olor debido a la deficiencia de hidrógeno en la composición puede remediarse por la combinación inmediata de un agente catalítico. Recientemente la demanda por toda especie de gasolina ha hecho dejar de lado el requisit ode buen olor y mediante otros procedimientos se produce mucha gasolina sintética. Por tales medios, residuos de bajo grado han podido rendir 20 a 70 por 100 de su peso de material que sirve como gasolina.

El procedimiento de generar las gasolinas por tales medios, no fué generalizado desde el principio, a pesar de sus ventajas; 1o. porque no había suficiente demanda de gasolina y 2o, porque la aplicación del principio traía consigo ciertos riesgos en un operación. Así, la descomposición que se verificaba mediante la acción combinada del calor y lo sobrepresión, con la formación de productos ligeros, originaba también la producción de aceites pesados y carbón libre, cuya proporción dependía del grado al cual se llevaba la operación. Como el carbón libre se deposita en el fondo del alambique formando costras duras (red spots) no era práctico, en el estado presente del arte, conseguir el resultado mediante la destilación destructiva bajo presión hasta sequedad. Pero recientes perfeccionamientos introducidos en la aplicación del principio han permitido llevar con éxito toda la operación sin riesgos ni demoras y así obtenerse procedimientos realmente industriales.

Hoy en los mercados se venden los productos titulados "motors spirits," así llamadas las gasolinas no muy puras fabricadas de los residuos de la destilación de los petróleos mediante el procedimiento de la destilación bajo presión y dicho "motor spirit" hace fuerte competencia a las gasolinas aromáticas obnidas en primera destilación.

Los "motors spirits" tienen en término medio 60 grados Baumé de gravedad, con un pronunciado olor, un color paja y se pretende que están compuestos prin-

cipalmente de hidrocarburos de la serie de las parafinas.

Dichos "motors spirits" son fabricados en su mayo proporción por la Standard Oil Co., de los Estados Unidos, mediante el procedimiento Burton. Así la Standard Oil Co. logra producir gasolinas que se venden a 3 centavos oro más barato por galón.

Como tan favorables resultados han despertado gran interés en la creación de nuevos procedimientos basados en el principio de la destilación de los reciduos bajo presión superatmosférica, es interesante conocer cuáles son los fundamentos de la patente Burton. (1)

La patente Burton (patente de los Estados Unidos No. 1.049,667 Junio 7 de 1913) ha sido transferida por su inventor D. William M. Burton, gerente de la refinería de Whiting, Indiana, de la Standard Oil Co. a esta compañía. La invención concierne al tratamiento de lso residuos de alto punto de hervir y particularmente los residuos de la destilación del petróleo del grupo o serie de las parafinas;; después los destilados de bajo punto de hervir producidos son separados para obtener productos de la misma serie de bajo punto de hervir.

Como se sabe, los métodos de destilación del petróleo crudo han sido perfeccionados en los últimos años para obtener la mayor cantidad posible de naftas. El punto de hervir de aquellas naftas o gasolinas oscila entre 75° y 350°F. Ellas dejan petróleo iluminante cuyo punto de hervir varía de 350° a 600° F., aceites lubricantes y ceras y como residuo aceites combustibles, los llamados gas olgasi oil cuyos puntos de hervir varían de 600° a 700° F. Ahora bien, el procedimiento de obtener gasolina de esos residuos por descenso del punto de hervir tiende invariablemente a convertir la fórmula del grupo de las parafinas Cn $Hn+^2$ a la del grupo etilénico Cn H^2n lo que hace el producto inaceptable en el comercio por su mal olor. Con el procedimiento Burton los combustibles y gas oil han sido tratados por destilación destructiva para obtenerse productos de bajo punto de hervir. Los vapores resultantes son conducidos a través de un condensador por medio de una cañería conectada con el alambique, llevando una válvula especial en la cañería para mantener la presión dentro del mismo. Los productos condensados con todo se encuentran haber sido convertidos en el grupo etilénico.

El objeto de la invención de M. Burton es tratar el residuo del grupo de la parafina de una manera tal, que el producto resultante de bajo punto de hervir sea de la misma serie de las parafinas, evitándose la serie de los etilenos. Esto lo verifica mediante elevación del punto de hervir del residuo líquido por medio de la presión sostenida sobre el líquido y vapores, los cuales son mantenidos bajo presión en todo su curso desde el alambique, a través del condensador y mientras dura la condensación.

El aparato empleado consiste de un caldero equipado de una válvula de seguridad, hogar, válvula de presión y termómetros. Una tubería conduce desde el extremo superior del domo del caldero a un condensador consistente en un serpentín sumergido en tanque refrigerador. Cerca de la extremidad más baja del serpentín una pequeña cañería lleva una válvula de socorro y más bajo cerca del suelo conectada con un recibidor para los productos de condensación, hay una válvula de cierre (shut off valve). Esta válvula normalmente está cerrada. La válvula de socorro permite el escape de todo exceso de gas superior a la presión. La presión con que el Shut off valve está cerrada es de 4 a 5 atmósferas, levantando el punto de hervir de 500 a 700 grados u 800° F. Esta presión combinada con la temperatura, aumenta grandemente la conversión de los miembros de alto punto de hervir de la serie de parafinas en miembros de bajo punto de hervir de la misma serie. El inventor no explica las razones por las que la sobre-presión sostenida produce tal resultado.

Los fundamentos declarados (Claims stated) de la invención son los siguientes:

"El método de tratamiento de las porciones líquidas de la serie de las parafinas de la destilación del petróleo teniendo un punto de hervir por encima de 500° F., de los productos volátiles constituyentes de tales líquidos, conduciéndolos y considerándolos y manteniendo una presión próximamente entre 4 y 5 atmósferas sobre tales líquidos y tales vapores completamente en todo su curso y mientras dura la condensación."

Como se ha dicho antes, el procedimiento de descomposición por destilación bajo presión da lugar siempre a la formación de hidrocarburos saturados y por consiguiente productos de mal olor y lo mismo sucede con la aplicación del procedimiento Burton coyos productos no obstante las pretensiones del inventor resultan siempre de mal olor.

Sobre este punto llamaré la atención hacia el descubrimiento del Dr. Day según el que debiéndose el mal olor de las gasolinas a la deficiencia de hidrógeno en su composición puede remediarse ello por la hidrogenación de las gasolinas mal olientes bajo la influencia de un agente catalítico.

Dicho descubrimiento, que ha sido aplicado en escala industrial, constituye la patente Day en los Estados Unidos, tanto la primitiva bajo el No. 826,089 de Julio 17 de 1905, como la nueva referente a sus mejoras inclusive el aparato No. 1004,632 de Octubre 3 de 1911. Dicha patente, en adición a la destilación bajo presión incluye la hidrogenación y por consiguiente la producción de productos aromáticos.

En este procedimiento los vapores de los hidrocarburos son mezclados con gas hidrógeno y puestos en contacto con un agente catalítico conveniente, con el fin de promover la combinación química del H y de los hidrocarburos no saturados de la serie de las parafinas.

El método Day parece tener la ventaja de producir una gasolina de olor agradable y del mismo carácter y calidad de las obtenidas naturalmente en la primera destilación del petróleo crudo.

Los fundamentos declarados de la invención son los siguientes:

1.—"La combinación de un alambique de petróleo con un hidrogenado comprendiendo dos cámaras de vapor y una cámara intermedia de petróleo, tubería conexionando las cámaras de vapor, la repartición entre la cámara de petróleo y una cámara de vapor, teniendo una abertura para el paso de los vapores a las tuberías y un cuello de ganso o cañería de escape de vapor conexionando con la otra cámara de vapor."

2.—"La combinación, en adición con una cañería principal, de un generador de hidrógeno, gas o vapor conectado con la cámara de petróleo."

3.—"La combinación con la cañería de producción de hidrógeno y su adicional cañería de escape de vapor con las dos cámaras de vapor."

4.—"La combinación de lo arriba mencionado con un generador para suplir gas caliente o vapor."

5.—"La combinación de lo arriba mencionado con una válvula para ejercer el contralor de la presión y temperatura del hidrógeno y vapor de petróleo destilado en contacto con un contacto material."

*Cubierta de Mastic para Estanques de Acidos.**

En relación con los trabajos de la Chile Exploration Co., en Chuquicamata (Chile), se ha puesto en práctica un nuevo método para cubrir o forrar los estanques de concreto destinados a sufrir la acción del ácido sulfúrico. Los minerales de cobre se tratan por el ácido sulfúrico en combinación con el método electrolítico; después de moler el mineral, se coloca en grandes estanques o depósitos y se le agrega una solución de ácido sulfúrico al 10 por 100 dejándolo durante 24 horas.

La solución que contiene el cobre se somete a otro procedimiento para extraer el cloruro y entonces pasa a los estanques electrolíticos; aqui se deposita el cobre y la solución restante, que se ha concentrado en ácido sulfúrico, puesto que se ha formado azufre proveniente de la descomposición del súlfuro de cobre, se lleva nuevamente a los estanques de concreto, que quedan listos para extraer el cobre de una nueva cantidad de mineral.

Se ve claramente que los grandes estanques de concreto necesitan resistir

(* Traducido de Mining and Scientific Press,

al ácido sulfúrico, cosa que el concreto no puede hacer, a menos que se le dé un revestimiento protector. Se hicieron, entonces, ensayos con depósitos de varios tipos, pero en la mayor parte de los casos fracasaron.

Para solucionar estas dificultades se propuso la idea de emplear un forro a prueba de ácidos hecho con mastic de asfalto; y al efecto, se fabricaron estanques (uno de 15 pies de alto), forrados con mastic de asfalto Trinidad, en el laboratorio de investigaciones de la A.S. y R.Co., Maurer, Nueva Jersey, el trabajo se hizo con la cooperación del consultor de la Chile Exploration Co., ingeniero metalurgista señor A.E. Cappelen Smith. Con estos estanques se duplicó, en lo posible, la operación de extraer el cobre tal como se efectúa en Chuquicamata.

Bajo la dirección de Mr. Smith, se ensayaron en Maurer otras materias, pero no resultó sino el mastic a base de asfalto. La resistencia de este material, que no ha sufrido deterioros ni demostrado defectos en las pruebas practicadas durante un año, es lo que ha inducido a la Chile Exploration Co., a forrar con el mastic más o menos ciento cincuenta estanques de concerto de 15 a 16 pies de profundidad por 120 o 150 pies en las dimensiones exteriores. Para revestir estos estanques con el forro protector, se necesitarán de 1,250 a 2,000 toneladas del mastic, que ya se está preparando y embarcándose para Chile. En Febrero fué el primer cargamento de 500 toneladas y tan pronto como llegue, lo que demorará unos tres meses, porque tiene que dar la vuelta por el Cabo de Hornos, se enviarán un superintendente y nueve operarios para efectuar la operación. El trabajo de experimentación, la preparación del mastic y su aplicación a los depósitos de concreto, estuvo en Maurer bajo la dirección de Enrique Wiederhold, administrador de la Compañía Pavimentadora Vulcanita.

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*Análisis Orgánico Cualitativo.**

Caracteres analíticos de las bases y cuerpos afines.

Estudiaremos en esta primera parte un cierto número de alcaloides, substancias que, encerrando más o menos, grandes cantidades de nitrógeno, manifiestan propiedades básicas y que forman sales, y además una cierta cantidad de cuerpos que la química moderna considera como derivados orgánicos del amoníaco, y otros que ,sin ser nitrogenados y de origen orgánico, tienen propiedades más o menos análogas a los alcaloides, como la digitalina, etc.

(*) De Revista del Centro de Estudiantes de Ingeniería de Buenos Aires, Argentina.

Propiedades químicas de los alcaloides.

Los alcaloides y los otros cuerpos que estudiaremos, son los unos sólidos a la temperatura ordinaria, y entonces generalmente cristalinos; los otros, líquidos. La división entre alcaloides volátiles y alcaloides fijos no puede ser admitida, pues un gran número de los considerados fijos, pueden sublimarse inalterados, a altas temperaturas. La mayoría de los alcaloides no combinados son difícilmente solubles en el agua, pero más o menos solubles en el alcohol, éter, alcohol amílico, benzina, cloroformo, etc. Sus combinaciones salinas con los ácidos fuertes, tanto minerales como orgánicos, son solubles en el agua, excepción de un pequeño número. Cuando se satura por el amoníaco o una base mineral, la solución acuosa de las sales ácidas de la mayoría de los alcaloides, y poniendo así el alcaloide en libertad, este último (excepto la curarina), puede ser extraído de al solución, por agitación con éter, benzina, etc., en una palabra, con líquidos que no se mezclen o casi nada, con el agua; inversamente el agua acidulada extrae completamente el alcaloide, de las soluciones de este último en el éter, cloroformo, etc., reteniendo estos disolventes las substancias extrañas.

Métodos generales de separación de los alcaloides.

Para separar los alcaloides de las materias orgánicas se pueden emplear diferentes métodos, entre ellos, los conocidos de Stas y Dragendorf.

En el método de Stas, las materias a examinar son tratadas por el alcohol, después de adición de ácido tártrico; la solución alcohólica evaporada es tomada por éter en presencia de bicarbonato de sodio. Tal es el principio de dicho método.

El de Dragendorf, que es el que adoptaremos, está basado en la solubilidad de los alcaloides, ya sea en solución ácida o alcalina, en ciertos líquidos, como ser: benzina, éter de petróleo, éter etílico, alcohol amílico, etc.

Veamos el procedimiento general.

La materia en la cual vamos a investigar el o los alcaloides, después de haberla dividido a gusto y criterio de uno, se somete a una digestión con agua diluída de ácido sulfúrico, a una temperatura de 40 a 50° lo más; se exprime, se filtra y se comienza una nueva digestión, hasta el número de tres como máximo, reuniendo después todos los extractos. Estos se evaporan hasta consistencia ligeramente siruposa, se mezcla el residuo con 3 o 4 veces su volumen de alcohol, se deja macerar durante 24 horas a 30° más o menos, y después de enfriamiento completo, se filtra para separar las materias no disueltas. Se lava el residuo sobre el filtro con alcohol de 70°.

Del líquido filtrado, se elimina el alcohol por destilación, se echa el residuo acuoso en un frasco suficientemente ancho y grande, se enfría, se diluye con agua si es necesario, y se filtra.

Como el líquido es ácido, se le trata a la temperatura ordinaria, agitándola frecuentemente con éter de petróleo rectificado.(Esta operación puede y es mejor hacerla en una bola dedecantación). Se decanta el éter de petróleo y se evapora a sequedad en vidrios de roloj.

Residuo proveniente de la agitación de la solución ácida con éter de petróleo.—Piperina, ácido pícrico, ácido salicílico, ácido benzóico, alcanfor y análogos, principios de la raíz del eléboro, principios del acónito y producto de la descomposición de la aconitina comercial, capsicina, aceites esenciales, ácido fénico y cardol.

El líquido acuoso del frasco, ácido como está, se agita de igual manera con benzina. Se evapora a sequedad.

Residuo proveniente de la agitación de la solución ácida con benzina.—Cafeina, cantaridina, anemonina, santonina, cariofilina, cubenina, hidroquinona, pirocatequina, resorcina, ácido salicílico, piperina, aleotina, colchina, digitalina, gratiolina, cascarillina, elaterina, populina, colocintina, colocinteina, principios de la pimienta, geissospermina, ácido crisámico, principios del vermouth y del ajenjo, anemonal y renonculol. Además: la cusssina, meyantina, ericolina, dafnina y enicina.

La solución acuosa del frasco, siempre ácida, es agitada ahora por el cloroformo y después de decantar se evapora a sequedad.

Residuo proveniente de la agitación de la solución ácida con cloroformo.—Cinconina, teobromina, papaverina, impurezas de la papaverina comercial, narceina, hidrastina, quelidonina, solanidina, esculina, ácido gelsémico, picrotoxina, eleborina, digitalina, convalamarina, saponina, seneguina, smilacina, liaconitina, myoctonina, aspidospermina, pereirina, brucina, sanguinaria, quebrachina, syringina, colchicina y colocintina.

Al líquido acuoso se le echa de nuevo éter de petróleo y se alcaliniza con amoníaco. Se decanta y se evapora a sequedad.

Residuo proveniente de la agitación de la solución amoniacal con éter de petróleo.—Estricnina, quinina, acontina, nepalina, delfinina, kairina, sabadilina, conydhrina, brucina, veratrina, emitina, aspidospermina, pereirina, gelsemina, quebrachina, oxiacantina, thalina, conicina, metilconicina, alcaloides del capsicum, sarracenina, lobelina, nicotina, esparteina, quinolina, trimetilamina, anilina y picolina.

La solución acuosa amoniacal se agita con benzina. Se evapora, después de decantada, a sequedad.

Residuo proveniente de la agitación de la solución amoniacal con benzina.—Atropina, hioscyamina, estricnina, etil y metil estricnina, quinina, quinidina, cinconina, cocaina, antipirina, narcotina, codeina, sabadina, taxina, tebaina, bru-

cina, eserina, pilocarpina, veratrina, sapatrina, delfinoidina, nepolina, niyoctinina y lycaconitina.

Se agita la solución acuosa amoniacal con cloroformo, se decanta y se evapora.

Residuo proveniente de la agitación de la solución amoniacal con cloroformo.—Morfina, cinconina, cinconidina, papaverina, narceina y barberina.

Se agita la solución acuosa amoniacal con alcohol amílico, se decanta y se evapora.

Residuo proveniente de la agitación de la solución acuosa amoniacal con alhol amílico.—Morfina, solarina, narceina, convallamarina, saponina, seneguina y salicina.

Tal es el método de Dragendorf, que nos permite caracterizar un gran número de alcaloides y substancias afines. Como estudiaremos solamente las substancias que trata el programa, he omitido las reacciones correspondientes a cada una, circunscribiéndome solamente a enumerar las substancias extraídas por tal o cual disolvente.

Reactivos generales

Mencionaremos un cierto número de reactivos que precipitan la mayoría de los alcaloides, pero sin ser capaces de caracterizarlos. Estos son los reactivos de precipitación Al lado de éstos, hay otros que dan, con la mayoría de los alcaloides, coloraciones más o menos características; son los reactivos de coloración. Veremos de ambos los más usados en la práctica y su manera de prepararlos.

Reactivo Mayer.—Es una solución de ioduro mercuro-potásico, preparada disolviendo 13 grs. 546 Hg. Cl_2 y 49 g. 8 Kl en agua y llevando a un litro. Este reactivo con las soluciones acuosas de sales de alcaloides o de éstos, da precipitados blancos o amarillentos.

Rectivo de Dragendorf.—El reactivo es un ioduro doble de bismuto y potasio. Se calienta el ioduro de bismuto con una solución de ioduro potásico; se filtra en caliente. Al líquido filtrado se agrega un volumen igual de solución concentrada a frío de oiduro de potasio. Da con los alcaloides en solución acuosa, acidulada un poco con H_2SO_4, precipitados rojo parduzcos.

Reactivo de Marmé.—Es un ioduro doble de cadmio y de potasio que se prepara igualmente que el anterior. Los precipitados obtenidos con este reactivo son blanco,s floconosos y que poco a poco se vuelven cristalinos.

Reactivo de Mandelin.—Es una solución de 1 gr. de vanadato de amonio en 020 c.c. de ácido sulfúrico concentrado. Con los alcaloides se tiene coloraciones distintas que pueden algunas veces ser características, p. e.: estricnina.

Reactivo de Schultz.—Se prepara agregando gota a gota una solución de cloruro antimónico a una solución de ácido fosfórico o mezclando 4 partes de fosfato sódico con 1 de cloruro de antimonio. Los precipitados obtenidos con la solución acuosa del alcaloide, acidulada por H_2SO_4, son amorfos y por lo general blancos.

Reactivo de Scheibler.—Se prepara disolviendo 200 grs. de tungstato sódico y 150 grs. de fosfato sódico en el agua y acidulando fuertemente con NO_3H. Completar a un litro. Precipita los alcaloides de sus soluciones acuosas aciduladas con un ácido mineral, en precipitados de aspecto amorfo y de color, por lo general amarillento. Es muy sensible. Igual reacción da el ácido fosfomolíbdico.

Reactivo de Wagner.—Se disuelve 12,7 grs. de iodo en un litro de agua conteniendo un poco de ioduro de potasio. Da por lo general precipitados pardos.

Reactivo de Erdman.—Se prepara echando a 20 grs. de H_2SO_4, 10 gotas de una solución de ácido nítrico al 4 por 100. Este reactivo da reacciones coloreadas con casi todos los alcaloides. El color varía según el alcaloide.

Reactivo de Froh.—Se agrega a 100 c.c. de H_2SO_4 concentrado, 0,1 gr. de molibdato sódico. Este reactivo da también reacciones coloreadas, que varían según la substancia.

Reactivo de Buckingan.—A 100 c. c. de H_2SO_4 concentrado se agrega gr. 0,1 de molibdato amónico. Es también un reactivo de coloración.

Otros reactivos de coloración son:

Reactivo de Wenzell que se prepara disolviendo 1 gr. de $KMnO_4$ en 200 c. c. de H_2SO_4 puro.

Reactivo de Lucchini, que es una solución recientemente preparada $K_2Cr_2O_7$ en H_2SO_4 concentrado.

Se usa además como reactivos generales de alcaloides las siguientes substancias: cloruro de platino, cloruro de oro (solución acuosa al 3 por 100), cloruo merrcúrico (13,55 grs. en 1.000 c. c.), tanino (10 grs. en 90 c. c. de H_2O y 10 c. c. de alcohol-,sulfoantimoniato de potasio, ácido pícrico. ácido sulfúrico concentrado y ácido nítrico concentrado.

Reacciones de los glucósidos.—Será conveniente indicar aquí también reacciones de los glucósidos, de los cuales un gran número nos dan reacciones de alcaloides y los estudiamos conjuntamente.

Estos cuerpos tienen la facilidad de desdoblarse bajo la influencia de fermentos, bases o ácidos, de tal manera que el azúcar es uno de los productos del desdoblamiento. Este desdoblamiento se efectúa en la mayoría de los casos. si se calientan, durantet un cierto tiempo a una temperatura de 100°, con ácido sulfúrico muy diluído (4 a 8 por 100). No reducen, por lo general, el nitrato de plata. No reaccionan con los reactivos generales de los alcaloides.

Reacciones particulares de los alcaloides.

Primer grupo del programa de química analítica.

(Primer curso.)

Narcotina $C_{22}H_{23}ON_7$

La narcotina se encuentra en el opio; es un cuerpo cristalizado, apenas soluble en agua fría, poco soluble en el alcohol mo.

y éter, fácilmente soluble en el cloroform-

1.—El R.° Frohde disuelve la narcotina dando una coloración verde. En caliente se cambia en rojo-cereza.

2.—El R.° Mandelin disuelve la narcotina dando un líquido pardo-rojo que se vuelve carmín.

3.—El agua de cloro da en las soluciones de sales de narcotina una coloración amarilla verdosa, que se vuelve rojo-naranja por adición de amoníaco.

4.—Tratada con ácido sulfúrico concentrado toma coloración roja por el calor.

5.—Disolviendo la narcotina en ácido sulfúrico diluido al 1/5 y concentrando la mezcla por el calor, se tiene un residuo rojo; este residuo enfriado y humedecido por una traza de ácido nítrico, pasa al violeta. Esta coloración se produce sin adición de ácido nítrico, cuando se calienta a 200°.

6.—Precipita además con Mayer, Marmé, Scheiber, ioduro de potasio y cloruro de platino.

Extracción según **Dragendorf.—Solución amoniacal con benzina.**

Quinina $C_{20}H_{24}N_2O_2$

La quinina se encuentra en las cortezas de las Quinquinas. Es un cuerpo sólido que se presenta bajo forma de agujas o de un polvo blanco. Es poco soluble en el agua, bastante en el alcohol, éter y cloroformo.

1.—El agua de cloro y el amoníaco produce una coloración verde pasando al azul por adición de un ácido. Un exceso de ácido hace pasar al violeta o rojo brillantet, pero el NH_3 agregado de nuevo, da otra vez el color verde. Sensible al $^5/_{1\,000}$. (André).

.2—Agregar a la solución del agua de Bromo una gota de cianuro de mercurio y un poco de carbonato de cal: color rojo. Sensible a 0.00 2grs. por litro. (Eiloart).

3.—El agua de cloro, el ferrocianuro de potasio y el amoníaco dan una coloración roja. (Flueckiger.)

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*Un principio Geológico que hay que tener siempre presente.**

Todos los materiales que se adicionan a la corteza terrestre o que se forman sobre ella, se encuentran luego sometidos a todas las acciones, que sufre ésta, es decir, las errosivas, metamórficas, tectónicas, etc., y las rocas manifestarán sus efectos, según su nturaleza.

Destacar este hecho ,es recordar que en muchos estudios geológicos, no se consideran las rocas eruptivas de derra-

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*Escrito por Federico G. Fuchs en el Boletín de Minas, Industrias y Construcciones.

me, efusivas, de profundidad, &., en los fenómenos tectónicos y de metamorfismo, con la misma importancia, que se concede a las rocas sedimentarias, de "edificación," precipitación, &., para seguir en ella los plegamientos, fracturas, fallas, derrumbamientos, &., desde que el conjunto de todas estas rocas, constituyen el block de la corteza terrestre, que se estudia.

También debe tenerse en consideración, las épocas en que se efectuaron las erupciones de estas rocas, para constituir parte de la corteza terrestre; diferenciar el grado en que han sufrido estas acciones y sus fenómenos consecuentes; tiempo que han actuado, &.

Cuando se principió a estudiar la corteza terrestre, se descubrió primero los efectos mecánicos de fractura, plegamientos, etc., en los terrenos sedimentarios.

Entre los depósitos sedimentarios, los arcillosos son los que manifiestan, con gran claridad, los efectos mecánicos, en especial los tectónicos, debido a su plasticidad, sus propiedades quíimicas y físicas. En efecto, los depósitos arcillosos, por efecto de la presión, son fácilmente sub-divididos en capas o mantos, dando lugar a las pizarras y esquistos. También estos últimos pueden ser producidos por acciones de resbalamiento, laminado, escurrimiento, ya solas o combinadas, pero generalmente las pizarras y esquistos, son producidos por presión o resbalamiento o combinación de los dos.

Las pizarras y esquistos arcillosos, sometidos a esfuerzos tectónicos, fácilmente ceden a ellos; si son tangenciales, plegándose y dando pliegues grandes y pequeños y formando todas las clases de estos, con neta claridad. Si las fuerzas son verticales, de flexión, de torsión o combinadas, las pizarras y esquistos arcillosos, se fracturan, fallan, y en conjunto con efectos tangenciales, se derrumban, se embuten en los vacíos dejados en otros sedimentos (más rigidos), por las fuerzas tectónicas.

Todos los fenómenos mecánicos, se revelarán con más o menos claridad, en las arcillas ,según la intensidad y como han actuado las fuerzas, así como el grado de plasticidad que tienen o han adquirido aquellas.

En las caras de junturas, generalmente pulidas, de las capas o mantos de pizarras y esquistos, cualquier acción mecánica que se haya producido en el paquete que forman ellas, deja marcas claras, para poder leer los caracteres de las fuerzas que han actuado: intensidad de estos fenómenos de resbalamiento, dirección de estos, etc.

Después de estas arcillas, las que le siguen en estas propiedades, en m grado y en orden decreciente, son: los esquistos talcosos, cloritosos, micáceos, las margas; todos éstos revelan, con claridad, los pliegues, fracturas, fallas, derrumbamientos y resbalamientos. Las dolomitas, calizas y areniscas cuarzosas, de acciones tectónicas, de plegamien- que sólo revelan netamente las grantos, fracturas, etc., y las nulas o casi nulas, representan el registro de estas acciones en las caras de junturas de sus mantos.

Todo el conjunto de las rocas sedimentarias, se "edificación," precipitación y sus congéneres, ha sido aprovechado para aminfestar las acciones tectónicas, ya por su naturaleza como hemos visto, como también por ser de diferentes clases y haberse depositado alternativamente, siendo éstas últimas condiciones, las que dieron lugar de preferencia, a que se reconociera que se habían depositado en diferentes épocas, y de aquí partió una primera clasificación rudimentaria, sedimentarias en edadesdes, teniendo en cuenta las condiciones estratigráficas.

Después vino la clasificación paleontológica, basada en los fósiles animales y vegetales, lo que hizo que la clasificación por edades, se fijase sobre bases sólidas.

Buscadas las causas de los trastornos tarias, se les atribuye luego a las rocas experimentados por las rocas sedimeneruptivas, porque éstas aparacen generalmente en las zonas más fracturadas y dislocadas, ya en grandes macizos o en pequeños, intercalándose en las fracturas, apareciendo debajo de los sedimentos, etc., como también por la impresión que produjeron las erupciones volcánicas, con su acción violentamente mecánica, y los productos que arrojan, que son rocas eruptivas semejantes a todas las otras que aparecen entre los paquetes sedimentarios de la vecindad y bajo ellos.

Por otra parte, las rocas eruptivas por su naturaleza, no dejan descubrir fácilmente las acciones mecánicas y parecía que ellas no las hubieran sufrido, contribuyendo más bien para que se les considere como las causantes. Dejando las rocas sedimentarias, veamos cómo se puede descubrir las acciones tectónicas en las rocas eruptivas.

Para las rocas de derrame, inyección en diques o masas, que se intercalan en las rocas sedimentarias, es fácil seguir, en conjunto con las sedimentarias, las acciones tectónicas sufridas. Se ve, en efecto, derrames que han sido de cierta extensión entre dos capas sedimentarias, que si éstas se han fracturado y fallado, lo mismo le ha pasado al derrame; los diques también se encuentran cortados por las fallas y sus secciones respectivas, trasportadas con el comportamiento sedimentario correspondiente: en fin, hay otras series de fenómenos en que se nota claro estas acciones. Pero la cosa se complica mucho para los grandes macizos de rocas eruptivas, de profundidad, las porfídicas o las graníticas y especialmente éstas últimas.

En efecto, los grandes macizos graníticos están constituídos por material más o menos homogéneo; es muy resistente para que por acciones mecánicas, se sub-dividan en capas o mantos, debido a que no es plástico, fácil a plegarse y por fin, como no está constituido por sucesiones de diferentes materiales, no es posible hacer una correlación de ellos y saber si un comportamiento del macizo, se ha movido o trasportado sobre otro, etc.

Ya hemos visto que los macizos de rocas de profundidad, se encuentran separados de los sedimentarios, con quienes se encuentran en muchos casos, solo en contacto periférico y debajo de ellas; de aquí que no se pueda relacionarlas ni para las acciones tectónicas que han sufrido ambos, ni para clasificarlas por edades en ciertos casos. Solo puede decirse que el macizo es anterior o posterior a tales formaciones sedimentarias con las que guardan cierta relación.

Al estudiar con detalles, estos grandes macizos de rocas graníticas, se vino en conocimiento que eran pasivas en su relación con las sedimentarias y que si algunas veces, efectuaban trastornos en éstas, era cuando sus erupciones tenían lugar durante la sedimentación y en otros casos, solo eran locales y de pequeña intensidad. Profundizándose más, se notó que no solo las rocas eruptivas de profundidad eran pasivas, sino que a su ve, habían sufrido fuertes acciones tectónicas.

En el estudio microscópico de las rocas, se notó que los elementos de éstas eran graníticos; en muchos casos, acusaban el haber sufrido las masas, acciones mecánica smás o menos fuertes, por encontrarse cristales rotos en la periferia, extensiones ondulantes de feldespatos y cuarzo, etc. Al describir los grandes macizos eruptivos, se ha indicado que las acciones tectónica ssufridas, eran las inyecciones de rocas eruptivas posteriores a su consolidación en forma de diques, necks, vetas, etc., y en este último caso, se han encontrado algunas falladas. Se ha indicado todo esto de una manera muy vaga o con mucha timidez, y en pocos casos, se ha opinado que las vetas que han aparecido en macizos graníticos, son rellenos de fracturas de acciones de flexión o torsión.

En cambio, hay muchos geólogos que ha nllevado las cosas de tal manera, que consideran las rocas eruptivas como provenientes de las sedimentarias, por metamorfismo, fusiones, etc., pero sin que se preocupen más de las acciones tectónicas, una vez que se han producido en esta clase de rocas.

Nosotros creemos que, en general, todos los grandes macizos de rocas graníticas y en especial, las que se encuentran en zonas débiles o fracturadas de la corteza terrestre, han sufrido fuertes acciones mecánicas que las han subdividido en compartimentos; en parte le han dado ligeramente un aspecto de capas o mantos y en otras han sido atravesadas por rocas eruptivas en difentes épocas, en forma de diques, necks, etc.; los compartimentos se han movido, dando fallas y fracturas varias, se

Continuará.

Informe Relativo a la Exploración de la Región Norte de la Costa Occidental de la Baja California.

Un elemento orográfico de bastante importancia y que se encuentra también en la Alta California, lo constituyen los llamados valles interiores, grandes depresiones con el fondo plano. Estos los hemos observado en lo general sólo en el límite de nuestra zona, como en Real del Castillo.

La zona de la costa estudiada por nosotros, no muestra en lo general alturas muy grandes. La región de las mesas entre Tijuana y Ensenada, tiene muy pocos puntos prominentes. Las mesas se levantan en lo general a una altura entre 300 m. y 400m., pero sobre ellas salen dos cerros muy prominentes, la Mesa Redonda (7720 m.) y el Cerro del Coronel de una altura casi igual.

Entre Ensenada y San Antonio del Mar, las sierras de rocas cristalinas y metamórficas se levantan a alturas mucho mayores, pero no muestran una altura más o menos uniforme como las mesas sedimentarias más al Norte. Entre el cañón de las Animas y el valle de Santo Tomás, se levanta el cerro de el fondo del valle de Ensenada mismo, la Soledad a una altura de 1,140 m. En encontramos el Cerro del Mogor con una altura de 1,200 m.

La sierra principal del interior de la Península se levanta entre Calamahí y San Borjas, a alturas bastante respetables, problamente a más de 1,500 m. Hemos atravesado el portezuelo de Santa Isabel a una altura de unos 700 m. y el portezuelo de San Juan a una altura de más de 1,000 m. Los cerros de los alrededores de este último lugar se levantan mucho más y es muy probable que pasen de los 1,500 m.

Más al Norte, en la región de la Laguna de Chapala, que se encuentra en el parte-aguas de la sierra principal, hemos observado alturas de unos 850 m., pero también allí se levantan los cerros bastante sabre la línea divisoria de las aguas y pasan probablementet de los 1.000 m.

Criaderos de piedras preciosas.

Tomando en consideración que en nuestra zona las rocas intrusivas en conexión de las cuales se hallan casi siempre las piedras preciosas de esta parte de América, solamente se presentan de una manera esporádica, se puede prever, desde luego, que hay poca esperanza de encontrar en aquella región piedras preciosas en cantidad y calidad suficiente para que una explotación sea costeable. La única piedra que se ha tratado de explotar es la turquesa. Esta se halla en vetas delgadas que arman en una roca sumamente alterada; ésta pertenece probablemente a una de las rocas producidas por las erupcionets porfiricas. La determinación de esta roca no se podrá hacer hasta que llegue a nuestras manos el material colectando. El único afloramiento de turquesa que hemos encontrado en nuestra zona, existe en la cuesta del Aguajito, entre el Rosario y la ex-misión de San Fernando. Se han hecho allí algunos pequeños trabajos de exploración a los cuales se ha dado el nombre de Mina de La Turquesa. Los trabajos subterráneos en tiempo de nuestra visita eran inaccesibles, de modo que sólo pudimos estudiar las caras superficiales y el material extraído. La turquesa se encuentra en este lugar en vetillas muy pequeñas formadas en una zona de fracturamiento; la piedra misma es de color azul-verdoso y bastante blanda. Es de sentirse que los trabajos no se hayan llevado hasta mayor profundidad para ver si las piedras allí no mejoraban en calidad. Lo que se ha encontrado hasta la actualidad no es de valor comercial; la poca cantidad y la calidad deficiente de la turquesa ha sido probablemente la causa por la cual no se han seguido las investigaciones.

Otra piedra preciosa que se encuentra en la región donde hemos viajado, es el granate. Este se presenta por una parte en pegmatitas y por otra en rocas de contacto. Las variedades comunes que no se pueden considerar como piedras preciosas tienen una distribución muy vasta. Granates finos se han encontrado con cierta frecuencia en las sierras graníticas del Norte de la Península (Sierra de Juárez), mientras que en la zona de la costa no han sido descubiertos hasta ahora y tampoco hay grandes probabilidades de hallarlos por las razones expuestas al principio de este capítulo. En la región entre el Rosario y Calamahi hemos visitado también el interior de la Península y allí hemos encontrado con gran frecuencia granates en las pegmatitas y algunas veces también en rocas de contacto (pizarras metamórficas). La mayor parte de estos granates pertenecían a las variedades comunes y los hemos hallado solamente en pequeños ejemplares que no se pueden comparar respecto a tamaño y desarrollo cristalográfico con los bellos ejemplares colectados por los Sres. T. Flores y P .González, en la sierra de San Pedro Mártir. En un lugar, el cañón del Aguajito entre San José y el Aguaje de los Sauces, hemos observado graantes bastante transparentes y de un tamaño un poco mayor, en anchos diques de pegmatita. Todavía no podemos llamar a estos ejemplares granates finos, pero de todos modos indican estos hallazgos que en este lugar, así como probablemente en muchos otros, una investigación detenida podría demostrar la existencia del granate transparente y de buen color que tiene cierto valor comercial.

Los granates finos de la parte septentrional de la Península hasta ahora no han sido explotados de una manera sistemática, lo que se explica en parte por el precio relativamente bajo que depende por una parte de la frecuencia relativa de esta piedra preciosa en muchos lugares de la tierra, y de otra por la circunstancia de que estas piedras baratas están sujetas a lòs caprichos de la moda; por ejemplo, a mediados del siglo pasado y en los siglos anteriores, se estimaba en mucho el granate rojo de Bohemia, mientras que actualmente ha bajado mucho en valor y se prefiere la variedad amarilla, la Hessontia. En el condado de aSn Diego de la Alta California. se explota mucho el granate; principalmente como producto accesorio en la producción de otras piedras preciosas como la turmalina fina y la kunzita. Parte de estos granates no se venden allí bajo este nombre en las joyerías, sino bajo la denominación de jacinto, y así se obtienen precios más altos. En realidad estos jacintos de California no tienen nada que ver con el verdadero jacinto que es un silicato de zrconio. En California se venden varias otras piedras preciosas bajo un nombre falso, por ejemplo, el topacio;; las piedras que bajo esta denominación se encuentran en las joyerías en California, especialmente en San Diego, o son legítimos y entonces no provienen de aquel condado, o no se trata de topacio sino de cuarzo ahumado al cual se ha dado el color amarillo exponiéndolo a los efectos de una alta temperatura. Estas sospechas nuestras nos fueron confirmadas por joyeros de San Diego.

Turmalina fina.

Otra piedra preciosa que se explota en el condado de San Diego, Cal., es la turmalina fina. Era desde luego hasta cierto grado probable que esta piedra se encontrara también en Baja California. En realidad el señor Dr. Wittich encontró la turmalina rosada en numerosos ejemplares, en pizarras metamórficas en el valle de San Pedro, entre Calamahí y San Borjas, y en otra localidad en la subida oriental al puerto de San Juan, cerca de San Borja . Los ejemplares encontrados no son de valor comercial, pero no era de esperarse, pues

se trata de material de la superficie; una investigación más detenida será necesaria para demostrar si en aquellas regiones se hallan también ejemplares completamente transparentes y de buen tamaño. Esta turmalina fina pertenece a la variedad de la turmalina de litio (Rubelita); la turmalina negra que es tan frecuente en los diques de pegmatita y en los granitos de Baja California, no tiene ningún valor comercial.

En San Diego, Cal., se utiliza con frecuencia como piedra ornamental un silicato de cobre, la chryscola, para hacer de ella pisapapeles, mancuernas para puños, botones, mangos para útiles de escritorio, prendedores, etc. Este mineral se encuentra también en varias de las vetas de cobre de Baja California y bajo circunstancias favorables podría ofrecer ametrial para una pequeña industria.

Mica.

Encontrándose en la actualidad cada día más aplicaciones para la mica, especialmente en la industria eléctrica, hemos dirigido nuestra atención a afloramientos de este mineral. Se encuentra con mucha frecuencia en diques de pegmatita, pero éstos son, como lo hemos expuesto en la parte geológica, muy raros en la zona de la costa, siendo seguramente mucho más distribuidos en la parte interior de la Península donde probablemente se encontrará también la mica con más abundancia. Mica en cantidad pequeña y que es absolutamente de valor nulo, la hemos encontrado con frecuencia, pero de una sola localidad hemos tenido noticias donde se encuentra la mica en tal cantidad, que de ella se pueden cortar hojas de algún tamaño. Esta localidad se halla cerca de la exmisión de Santa María; no hemos podido visitar este lugar por estar completamente fuera de nuestra ruta.

Materiales de construcción y para otras aplicaciones industriales.

Bajo las condiciones actuales los materiales de construcción, con la única excepción del tecali u ónix, son solamente de importancia local; una explotación en mayor escala puede tener lugar cuando la Península obtenga una población mucho más densa.

Es un hecho singular y que solamente se explica por la vecindad de los Estados Unidos del Norte, que en casi toda la zona estudiada por nosotros se construyen las casas con preferencia de madera importada de los Estados Unido , no obstante de que en todas las depresiones de los ríos y arroyos se encuentra un buen material para la fabricación de adobe y en muchos para la de ladrillo. Así, por ejemplo, se encuentran en la capital del Distrito, en Ensenada, casi con la única excepción de la Aduana y del cuartel, solamente casas de madera, una circunstancia que ofrece un peligro muy grande, pues un incedio en una de las casas podría ser la causa de una destrucción total de la ciudad. Las mismas condiciones encontramos en lugares pequeños como Tijuana y San Quintín, así como en los ranchos de los propietairos hacendados; solamente en lugares más antiguos, con especialidad en los que se levantan en el sitio de antiguas misiones, como San Vicente, Santo Domingo y el Rosario, o en pueblos hasta donde no se ha extendido todavía la influencia de los americanos o donde el transporte de la madera era costosa y difícil, se ha conservado el antiguo método español y mexicano de construir las casas de adobe. Para el clima de Baja California, la construcción de adobe parece la más adecuada y la más barata; su resistencia está demostrado en los edificios de las antiguas misiones que no han sido destruídos por completo ni allí donde han perdido su techo y donde nadie ha tomado cuidado en conservarlos; en Santo Domingo, parte de las casas de adobe de la antigua misión está casi intacta y habitada actualmente, sólo porque se ha tenido cuidado de componer de vez en cuando los techos. Todos estos edificios de las misiones existen ya más de 60 años, muchos probablemente más de 100; una casa de madera dura en lo general solamente unos 20 años, y si se cuida bien, a lo más 30 o 40 años.

Un material muy superior y más resistente sería, naturalmente, el ladrillo. Este casi se utiliza en las construcciones de nuestra zona y tampoco se fabrica en ninguna parte, no obstante de existir material propia para su fabricación en muchos lugares. Barro para ladrillos ofrecen las capas arcillosas del Cretáceo superior y del Terciario, además las tobas del pórfido y de los basaltos y especialmente los productos de descomposición de todos éstos; sobre la grande distribución de estas rocas, hemos hecho indicaciones en la parte geológica.

La cal necesaria para la argamasa hace gran falta en muchas partes de nuestr zona, de tal modo que se utiliza hasta las conchas del mar, para fabricar cal. En la parte geológica hemos indicado los lugares donde se encuentra la caliza del Cretáceo medio, la más propia para la fabricación de cal viva. De cierta importancia es el afloramiento en las cercanías de San Isidro del Mar, que se encuentra en las inmediaciones de la costa y qeu podría ser llevada en buques hasta Ensenada y otros lugares de la costa. Otro depósito existe cerca de la desembocadura del valle de Santo Tomás, en una región deshabitada.

Material para la fabricación de cemento se encontrará con seguridad en las arcillas y margas del Cretáceo superior que se encuentra en casi toda la costa, desde la Punta del Descanso hasta la bahía de Ensenada y desde San Isidro del Mar hasta la Punta de Canoas. Lugares donde la roca promete dar un material bueno son bastente frecuentes; citaremos aquí sólo las margas de los alrededores del Rancho Mégano, las margas con Turritellas y las capas encima de ellas en el cabo de Colnet y las margas con Inoceramus en la costa de Playa de Santa Catarina.

Es muy abundante la piedra de cantera en la parte de nuestra zona; a esta plase pertencen principalmente andesitas y tobas andesíticas, granito y diorita; el pórfido e sdemasiado duro y difícil de labrar, además no presenta colores hermosos. Las andesitas y tobas andesíticas que se encuentran en la parte oriental del Sur de nuestra zona ya han sido utilizadas por los misioneros para la construcción de sus iglesias y misiones (San Francisco de Borja) dan una cantera de color claro y uniforme, fácil de labrar y bastante resistente; se asemeja a la cantera que se usa en el valle de México.

En la explotación de los granitos y las dioritas para piedras de cantera, no se puede todavía pensar, pues éstas rocas duras y costosas se utilizan solamente en edificios monumentales, en la construcción de puertos grandes, etc. Además, debemos decir que el granito que se encuentra en la parte septentrional de nuestra zona y cerca de la costa, no es una piedra de primera clase sino est ácasi siempre lleno de manchas que provienen de inclusiones de dioritas más obscuras. Esto nos manifiesta, por ejemplo, el monumento de Hidalgo en Ensenada erigido allí en 1910. El zócalo está construíído de granito del cañón del Gallo y muestra en todas partes una infinidad de manchas obscuras que contrastan con el color claro del granito. Granito de mejor calidad y hasta de muy hermoso color, se encuentra en las sierras interiores donde fué hallado por las otras comisiones. Nosotros hemos visto variedades bellas de granito en el Sur, especialmente en las sierras de Calamahí y en aquellas entre Punta Prieta y la laguna de Chapala.

La diorita es en lo general de color más obscuro, es de por sí una piedra menos propia para edificios monumentales y se encuentra también con menor frecuencia.

Balastre para caminos, verdaderamente bueno, se encuentra en grandes cantidades. Las que son más a propósito son el pórfido y el basalto. Son densas y duras y no contienen elementos tan quebradizos como los grandes feldespatos de los granitos. Nuestra experiencia nos ha enseñado que allí donde los caminos entran en terreno compuesto principalmente de pórfido, éstos vuelven a ser buenos y duros, aun allí donde de por sí no existe un camino bien construído sino uno que se ha formado más bien por la acción de los carros mismos.

Material para alfarería se encuentra en los productos de descomposición de las capas cretáceas superiores y quizá también del Terciario. Barro bastante bueno se encuentra, por ejemplo, en la playa de Santa Catarina, debajo de la arena marina. Seguramente se hallará

el mismo material también en otros lugares más favorables.

Un material de construcción y de ornamento es el llamado Onix o tecali. Hasta ahora se conocen en Baja California dos depósitos de alguna importancia, ambos fuer ade nuestra zona y estudiados por las otras comisiones. Nosotros hemos encontrado un pequeño depósito en la cañada de la Misión Vieja (San Miguel), pero este hallazgo no es de importancia técnica por ser demasiado pequeño. Respecto a los depósitos grandes mencionados arriba, que son los de la New Pedrara Co. y los del Cerro Blanco al Este del Rancho de Santa María, nosotros hemos observado principalmente el transporte del material y su embarque en la playa de Santa Catarina. Hemos observado que los trabajos de la New Pedrera Co. constituyen un gran beneficio para toda la región, dando trabajo a numerosa gente, haciendo posible la existencia de Santa Catarina y facilitando a los habitantes de la región la importación de los productos necesarios. La Compañía del ónix de Cerro Blanco, todavía no ha empezado sus trabajos de explotación, pero sí ha construído un camino carretero que está terminado con excepción de un tramo pequeño, y además se ha principiado la construcción del muelle, bodegas, etc., en San José, necesarios para el embarque de la piedra. Las obras han sido interrumpidas temporalmente, pero es de desearse que empiecen de nuevo porque van a dar vida a una región que en la actualidad está casi deshabitada. El ónix no tiene consumo en la Baja California misma, sino todo el material se exporta a los Estados Unidos. Una gran ventaja para la exportación es la cercanía de California y es de esperarse que el ónix tenga pronto más y más demanda, pues se ha encontrado últimamente la manera de utilizar también en gran escala las piezas pequeñas que antes casi eran sin valor.

Petróleo.

Ya hace muchos años fueron descubiertos algunos vestigios de petróleo; y era de antemano probable que en cualquier parte de la Baja California se iba a encontrar este combustible, porque alcanza 164 m.; existe uno todavía mos medido la altura del Cerro Ceniza un poco más alto al Norte del primero, el Cerro Kenton, pero éste seguramente tampoco llega a una altura de 200 m.

Al Norte de El Rosario las mesas vuelven a levantarse a mayores alturas. La mesa de El Rosario tiene una altura de 250 m., las mesas entre el Rosario y la Playa de Santa Catarina, se levantan unos 400 m. sobre el mar. Hacia el interior se levantan las sierras de rocas cristalinas a alturas algo más grandes.

Entre Santa Catarina y la desembocadura del río San Xavier, se levantan los cerros y las mesas imperfectas hasta alturas de unos 600 a 800m., pero no se observan alturas uniformes, sino en muchos lugares se levantan sierras sobre sus alrededores.

Los grandes llanos entre el río San Xavier y Ojo de Liebre, apenas se levantan unos 10 m. sobre el nivel del mar. y sólo en unos cuantos puntos pierde la sierra principal considerablemente de el oriental, se observan mesas no muy extensas y de forma no muy perfecta. El centro lo compone una alta sierra muy escabrosa formada principalmente de granito y pizarras metamórficas. Este caráctetr del paisaje sigue hacia el Norte de una manera bastante uniforme que esta Península forma la continuación directa de la Alta California, en uya parte meridional abunda tanto el petróleo.

Los geólogos Emmons y Merrill, cuyo trabajo hemos citado arriba, encontraron huellas de petróleo en el Cretáceo Superior de los acantilados de la playa de Santa Catarina. Nosotros no hemos visto petróleo, pero sí hemos encontrado chapopote cubriendo y tiñendo las arenas de la playa, por ejemplo cerca de San Antonio del Mar; además se hallan allí con frecuencia grandes pedazos de chapopote eyectados por el mar. Otro lugar donde el chapopote se encuentra con frecuencia en la playa, es la Misión Vieja.

Sobre la importancia de estos hallazgos no se puede decir todavía nada, pues en ninguna parte se han hecho trabajos de explotación hasta ahora, con excepción de un pozo ejecutado hace tiempo en la hacienda de San Antonio del Mar. Esta perforación llegó hasta una profundidad entre 800 y 900 pies; en los primeros 600 pies se encontraron únicamente las arcillas azuladas con grandes concreciones calcáreas; capas que con seguridad pertenecen al Cretáceo superior; más abajo se encontraron 50 pies de arena, después una roca calcárea y entonces otra vez arena. Este pozo no ha dado resultado respecto a la existencia de petróleo, pero esto no es una prueba estricta, pues la perforación no llegó a profundidades muy grandes y por consiguiente no ha sido colocada en un lugar que llena todos los requisitos, pues no perfora todo el espesor del Cretáceo superior y nada del Terciario. Los propietarios de la hacienda de San Antonio del Mar tienen la intención de hacer otra perforación más profunda y la hará nprobablemente en la mes adel cabo de Colnett, donde van a atravesar toda la serie de capas marinas existentes en la región.

Si se llegara a encontrar petróleo en cantidades en el Norte d ela Baja California, sería esto de suma importancia para toda la Península y hasta para la costa occidental del continente, pues de esta manera se obtendría un combustible barato, cosa que falta en lo absoluto en la actualidad y que impide en varios sentidos el progreso de la Península.

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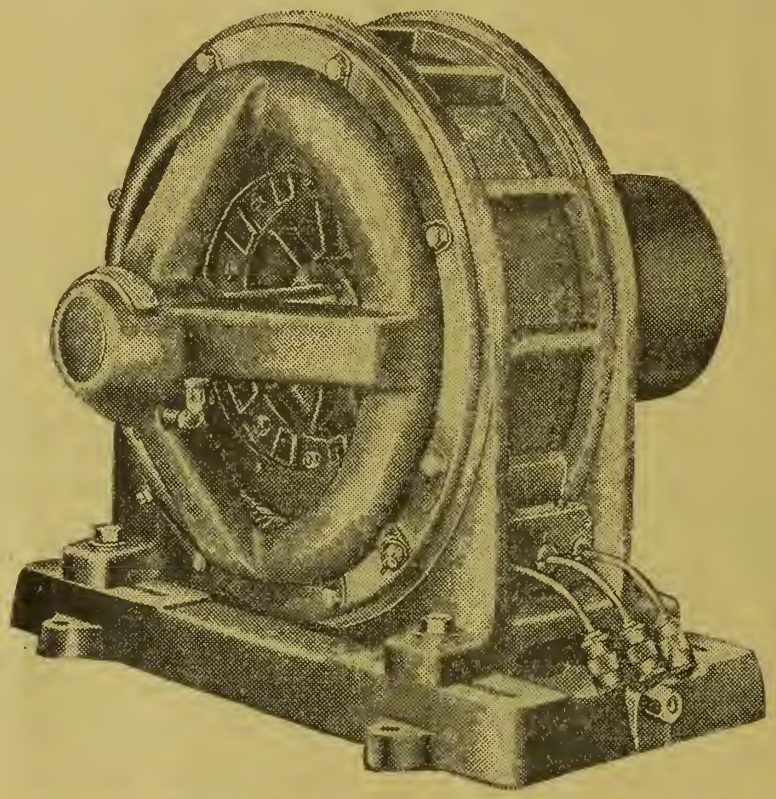

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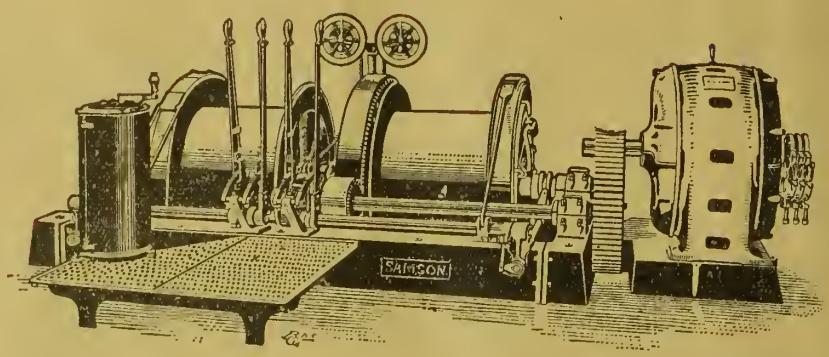

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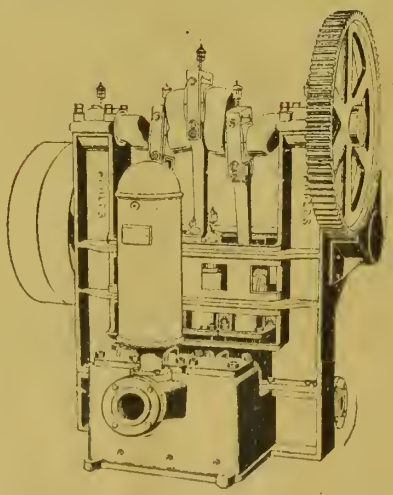

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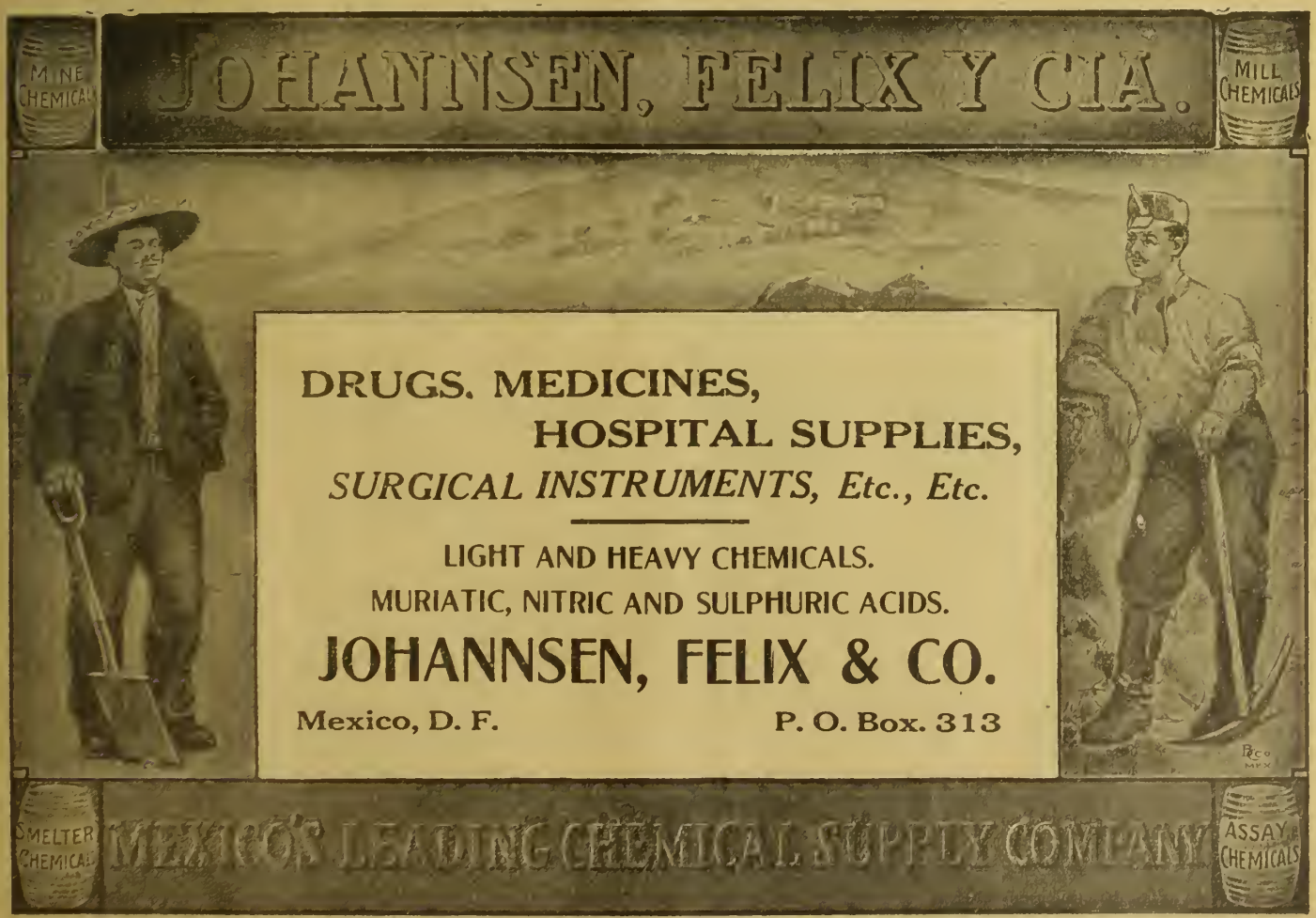

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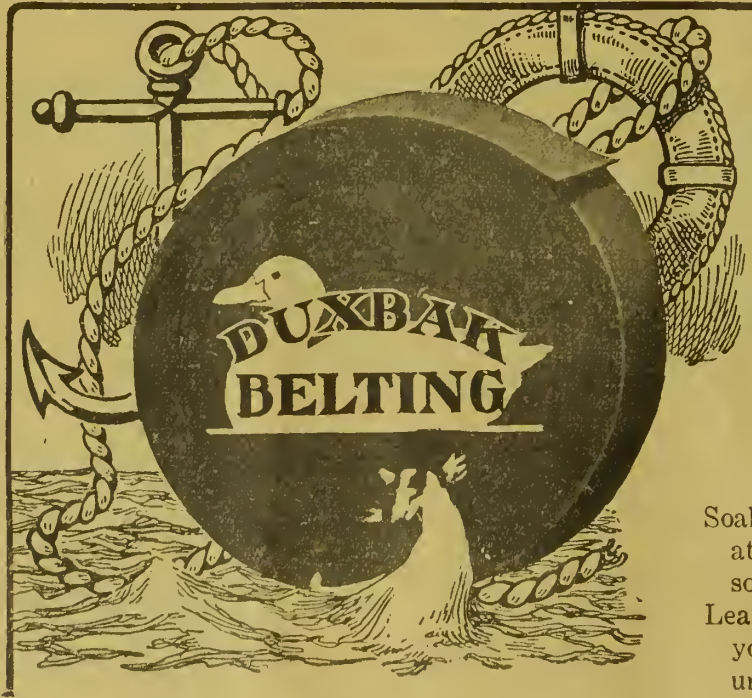

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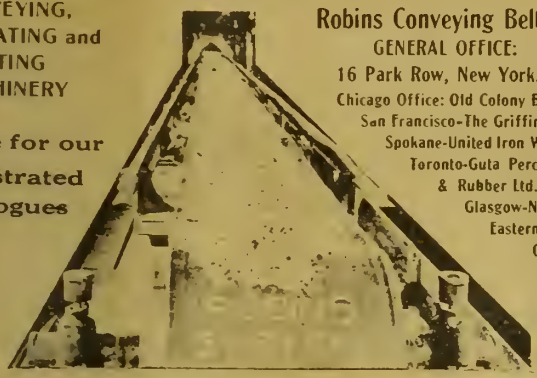

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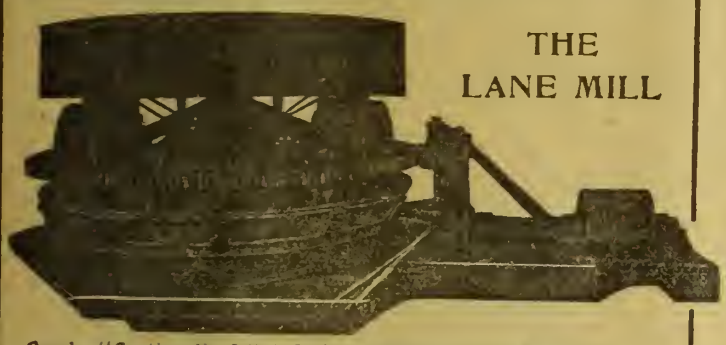

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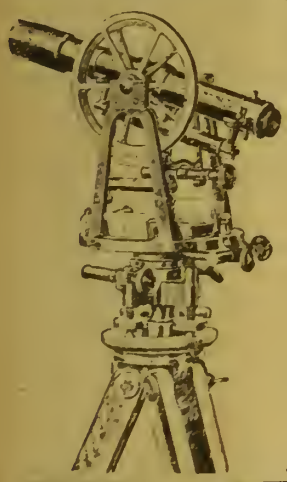

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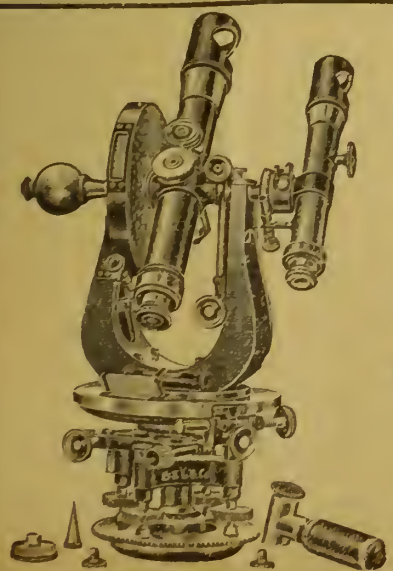

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